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A NOBLE GIFT.

At the annual meeting of the American Institute of Electrical Engineers this week, announcement was made officially of the gift to it by Dr. Schuyler Skaats Wheeler of the magnificent Latimer Clark electrical library, the finest and most complete collection of its kind in the world. If our readers will refer to the article elsewhere in this issue they will realize what a prize the generosity of the donor has secured for the Institute. While the sister society in England may deservedly boast its superb Ronalds library, the American Institute has beyond doubt secured the best thing of its kind extant, with a grand total of nearly 7000 entries, all relating specifically to electricity.

This is the first gift that the Institute, now nearly 18 years old, has received from any of its members, some of whom pass for millionaires, with fortunes made entirely out of the development of electrical industry. Dr. Wheeler is not at all a rich man, as values go in these times, but he has always shown a keen appreciation of the truth of Lord Bacon's dictum, that a man owes not a little to his profession. It is mere justice here to record that Dr. Wheeler, in this latest evidence of professional feeling, only exemplifies the impulses that have marked his whole career. He was the first life member of the Institute, and some years ago, when it was proposed to secure a home for the body, his was the first subscription to go on the list and be paid.

The Institute now has the finest electrical library in the world. But such gifts carry obligations on the part of the recipient, and there must be reciprocity. The society has the library, but it must be housed and catalogued and rendered available to the public, and here lies an opportunity for every individual member. We nourish the belief that the Wheeler gift will stimulate the professional pride of every member of the Institute, and lead to an outpouring of contributions that will at once double and quadruple the intrinsic value of the society's possessions. There have been other electrical book collections in this country of notable merit—the Benjamin, Weston, Graham Bell, and others—but for the first time the literature of the art, its records, its genealogy, and its beginnings have now been made available to all comers. It is impossible to handle these old volumes in monkish Latin, black letter, archaic English, high Dutch, and all manner of phraseology, without realizing the sweep and continuity of it all, from Albertus Magnus down to the recent Conversazione.

Dr. Wheeler suggested conditions for his deed of gift which were accepted by the Institute. They are reasonable, being aimed at securing the greatest public benefit from a unique collection, which can never be duplicated. Just now the press is ringing with the story of the purchase of the Leyland steamship line by Mr. Morgan, and our friends in England seem to be perturbed over the transaction. We may be in error, but it strikes us as altogether better, nobler and more fruitful achievement to have secured for America once and for all this greatest electrical library, whose influences and inspirations will go on and on, long after steamship lines have ceased to be. In such gifts lie enduring fame.

NEW CONSTITUTION OF THE A. I. E. E.

The new constitution adopted this week at the annual meeting of the American Institute of Electrical Engineers, gives that body a

carefully-considered and up-to-date set of rules for its guidance. The desirability of a radical revision of the constitution just superceded, which was adopted in 1884 and amended in parts in 1885, 1892, 1894 and 1896, has been considered by the Council repeatedly in the past six or seven years. Several committees during that period have made drafts of constitutions, and the instrument just adopted, though containing some original features, is largely based upon these previous drafts. Perhaps the most important changes introduced in the governing rules by the new constitution are the provisions for State and District organizations; the definition of qualifications for full membership; the addition of the two junior past-presidents to the managing body; the increase of full membership dues, and the method whereby the constitution may be amended. Many minor changes are incorporated, most of which have for an object to give the Institute a more thoroughly National character and to render it more difficult for its governing body to fall under the control of a faction, or should this occur, to limit the injury that may be done. Legislative action affecting the policy or organization of the Institute is now restricted to the annual or corporation meeting in May and the annual convention. A change made in the date when the officers take office, gives the president almost an entire year of encumbancy previous to the annual convention, thereby enabling him to make this meeting the crowning success of his administration. The importance of this meeting is further enhanced by the provisions whereby territorial bodies of membership may send delegates whose traveling expenses will be borne by the Institute.

Owing to the laws under which the Institute is incorporated it was found advisable to change the name of the governing body, which is now to be known as the "Board of Directors," instead of "Council." The addition to this body of the two junior past presidents is an important feature, since it will conduce to greater continuity in policy and action. Under the old constitution it was possible to adopt amendments at any monthly meeting in New York City. Hereafter proposed amendments must be submitted for action to the entire membership, and only once annually. The definition of the qualifications necessary for full membership, though radical as compared with that in the constitution superceded, merely renders definite and authoritative the criteria which for several years past have been applied by the Board of Examiners and Council in passing upon applications for transfer. An increase in the dues of the full members was not contemplated originally, but knowledge of the large additional expense to which the Institute would soon be subjected through its library, rendered it imperative that the income of the Institute be increased. We believe the entire membership will be satisfied that the burden should fall rather on the full members than be distributed so as to include associates, if for no other reason than that the objects of the Institute appeal with much greater force to the former than to the latter. A change affecting those in the future transferred to full membership, consists in the requirement of a fee of $10 upon transfer. As an offset to these increased burdens, the offices of president and vice-president are restricted to full members.

The rules for the nomination and election of officers are not materially changed, but two important provisions have been added. One of these requires that in the preparation of the "Directors' Nominees" ticket the names for the office of vice-president shall be selected with a view to maintaining a geographical distribution of incumbents of that office. The desirability of this provision is illustrated in the recent council ticket, the three nominees for vice-president which it bore being all from New York City, and two from the same college. The other addition referred to is that which provides for placing the name of a second nominee on the "Directors' Nominees" ticket, to be selected from the four names receiving the highest number of nominating votes for president. As the official nominees are under normal conditions invariably elected, the choice of president lay in the past practically with the council. In the selection of the second name by the Board of Directors, considerations of the relative number of nominating votes will probably not have as much weight as when there was but a single name, which condition should give to the independent engineer a better opportunity than he has had in the past, to attain to the presidency against the odds in favor of a candidate connected with a great commercial interest or with a university having a numerous alumni representation in the Institute membership.

THE NEW EDISON STORAGE CELL.

It was with great interest that we have seen the facts concerning Mr. Edison's new storage cell definitely set forth in the paper upon this subject read this week before the American Institute of Electrical Engineers, and reproduced in this issue. So many inaccurate notions have been formed of late concerning this cell, partly owing to a certain German patent recently granted to Mr. Edison for a cadmium storage cell, that it is gratifying to receive a clear and practical authorized statement of the facts.

The great advantage of the new cell is that it is structurally composed of steel instead of the eternal lead of the past, a relatively weak and heavy metal. Mr. Edison is said to have observed some years ago that if the Creator had intended that lead should be used in a storage cell, he would not have given to that metal its high specific gravity. With steel plates the structure of the cell can be designed for strength and rigidity with the minimum mass of inactive material. Another advantage of the cell is its absence of "formation," or the period of incubation through which the leaden cell has to pass in order to develop its storage capacity. We understand that when the chemical salts are inserted in the receptacles of the plates, they are ready for charging in the ordinary way, which is an obvious advantage. There is one disadvantage about steel for plates, however, and that is that it cannot be cut or molded with the same facility as lead, and that special dies and tools are necessary for the stamping and filling of the plates. This means, of course, some extra delay in the preparation of the cell for the market. It would seem that all the measurements and experience collected upon this cell under Mr. Edison's direction and supervision within the last six months, have been made on small plates containing each a single pocket or briquette of active material, and that although the machines for cutting and pressing larger, or multiple-briquette plates, are in course of manufacture, the full-sized cells have not yet made their appearance.

Although the e. m. f. of the new nickel-iron cell is only a little more than half that of the lead cell, yet if 14 watts per pound of cell can be obtained from it, the nickel-iron cell will deliver at least twice as much electrical energy as the same weight of lead cells of which we have reliable data based on extended use. Of course, pasted lead cells can be made to give, when new, even more than 14 watts per pound; but their lives under active work would be short and have not the merit of being even merry. The fact that the alkaline solution of the cell does not enter into chemical combination, but remains chemically unaltered during charge and discharge, is another advantage. Part of the fall in e. m. f. of the lead cell during discharge must be attributed to local chemical exhaustion of the acid solution in the pores of the plates. Although it will not be possible to gauge the degree of charge or discharge of the new cell by means of the specific-gravity indicator, yet the voltmeter may perhaps give sufficiently this important information. As for the change from an acid to an alkaline electrolyte, there is but little to be said. One can destroy carpets, clothes

and epidermis, almost equally effectually with acid as alkali. The alkali will probably, however, have to be kept out of free communication with the air, or it will absorb atmospheric carbonic dioxide, to its own detriment, and the grief of the user.

We are glad that Mr. Edison has once more turned his great inventive talents to electrical problems. The storage battery for tractive purposes is a crying need of the day. We understand that this new cell is the result of more than half a year's research on his part, not including the work of his assistants. With a good, reliable storage cell, the electric automobile can distance all the competition of steam and gasoline for city work. The noiselessness, cleanliness, smoothness of running and convenience of the electric automobile would easily give it the preference to-day if it were not for the weight and depreciation of the leaden storage battery, which handicaps it like a veritable old man of the sea on the back of Sindbad the sailor. We sincerely hope that Mr. Edison has thrown off the incubus. Curiously enough, the substances entering into the action of the cell are all magnetic substances. The grids or plates are of steel. The active materials are oxides of nickel and iron, the two most magnetizable known substances, while oxygen, the active transfer has also a relatively high magnetic permeability.

POWER TRANSMISSION FOR CENTRAL STATIONS.

We are publishing this week an interesting resumé of high voltage power transmissions as practiced in New York City, in a paper by Mr. Calvin W. Rice, prepared for the National Electric Light Association. This power transmission work has developed so quietly, and with so little spectacular effect, that its amount and importance is hardly realized until one comes to take account of stock in detail. We fancy that the first paragraph of Mr. Rice's paper will rouse the controversial spirit of the convention in a way that will be enlivening even if not entirely edifying. Without desiring to take sides violently upon a mooted point regarding which so much can be said from many standpoints, we would mildly suggest the following paraphrase of the paragraph as being more strictly in accordance with a conservative view of the facts. "In America the system which first came upon the field, and which deeply rooted itself in nearly every large city before a rival came into sight, was the low tension Edison 220-volt direct-current, three-wire system. It has proved to be remarkably well adapted to miscellaneous lighting power and industrial work." While recognizing its many valuable properties, we are not prepared to admit that if one could start *de novo* in any large city, an equally efficient and economical and generally useful system could not be installed using a distribution exclusively by alternating currents. But in this workaday world we have to take things as we find them, and the fact is that the Edison system has fixed itself so firmly, has invested so large an amount of capital and established so complete a network in almost every large American city, that its extension along similar lines is almost a necessity even if it were not a matter of choice. Obviously the Edison tube system which has been so successful and in which so great an investment is locked up, does not lend itself readily to distribution by alternating currents, and even if the Edison companies desired to change their system, which is by no means the case, they would hesitate, even if it were shown that the alternating system would be decidedly superior in a new plant—a thesis which is as yet far from being proved. Hence logically, the growth of such systems must take place, for the present at least, along the lines which Mr. Rice has so clearly indicated.

The importance of linking together the whole network of a city has made the power transmission at high voltage imperative and, thanks to the development of high-voltage generators and the introduction of rotary converters, the process of transmission and conversion has been rendered very efficient. With rotaries at both ends of a line, permitting an interchange of current between two generating stations, Mr. Rice states that a complete efficiency of 81 per cent has been reached reckoned from one direct-current switchboard to the other. This implies admirable machinery and good engineering, both of which the New York Gas Company, whose system Mr. Rice chiefly describes, certainly has at its command, as the record of past years testifies. Mr. Rice's description of the great waterside station with its projected capacity of 125,000 horse-power is most striking and instructive, but with the skill and enterprise exhibited in this colossal undertaking and the immense investment required, we are impelled to ask, as we have more than once suggested in these columns, what good reason there is for adopting a frequency which prevents the successful distribution of alternating current for incandescent lamps, in case such a step should ever become desirable? There is from an engineering standpoint absolutely no good reason for carrying the frequency just below, instead of just above, the point at which incandescent lamps can be readily operated. It seems a bit short-sighted not to provide for so possible a contingency. Of course, frequency changers are always available for small auxiliary alternating work, but the use of such apparatus on any considerable scale is simply a confession that somebody has blundered. It must be remembered that substantially all the revolutionary suggestions for improved electric lighting apparatus which has been in the air, as it were, during the past five years, imply the use of alternating current in the lamps, and there is at least a possibility that some of these may materialize, perhaps in the very near future. Of course, there is a chance that 25 cycles would prove advantageous even in such a contingency, but it seems, on the whole, a considerable handicap.

A very interesting feature of Mr. Rice's paper is the practical information given concerning high-voltage underground work. An instructive point is the limiting size of cable that can be installed in an ordinary three-inch duct. One would hardly suppose that a 2⅝-inch cable could be installed with considerable facility, while one only a sixteenth of an inch greater in diameter involved really serious difficulties, but such proved to be the case. The one size was just approaching the limit, the other had reached it. As to the insulation required for such cables, this and much other recent experience seems to show that for rubber compound containing 30 to 40 per cent of pure Para, a thickness of about 1-32 of an inch per 1000 volts around each conductor is necessary at pressures of 5000 volts and upwards. It is interesting to note that the paper-insulated cables have given good results as a substitute for rubber, and recent advices from abroad seems to show that cables for underground work are likely to depend less and less on the use of rubber, which, in the growing scarcity of that commodity, is rather gratifying information. We never remember seeing the heating limit in the underground ducts before stated in the simple terms set out in this paper. Two watts energy dissipated per duct foot is an easy figure to bear in mind and is well worth remembering. The device of serving the cables at manholes with a fireproof covering of asbestos and steel tape should also be noted as a good insurance against accidents. In high-voltage underground work the results of a short circuit may be so serious and difficult to remedy, that the only really safe procedure is to take extraordinary precautions against such mischances. The history of early experiments on underground service is full of tales of woe, but in the present state of experience many valuable lessons have been learned, and with the present precautions there has been very little interruption of service, even of a trivial and temporary character. The record of the metropolitan lighting systems in this particular is wonderfully good, considering the difficulties with which they have had to contend, and they deserve great credit for the issue.

Annual Meeting of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers, which was held in New York on the evening of May 21, was largely attended, and the proceedings were marked by a lively interest on the part of the members present. President Carl Hering was in the chair, and announced, after the regular business of the meeting had been concluded, that the Latimer Clark library, recently described in these pages, and of which a more detailed account is given elsewhere in this issue, had been presented to the Institute by Dr. Schuyler S. Wheeler. The announcement of this generous gift of Dr. Wheeler's was received with enthusiastic applause by the attending members. A number of prominent members of the Institute were necessarily absent attending the National Electric Light Association Convention at Niagara Falls, and a telegram was read from the absentees expressing their regret at not being able to be present at the annual meeting, and voicing their appreciation of the magnificent gift of Dr. Wheeler.

The next business in order was the action to be taken upon the adoption of the new constituion, which has been in preparation for some time, and which presents a number of notable changes relating to the Institute's organization. Mr. John W. Lieb moved the acceptance of the constitution, and Mr. Charles P. Steinmetz seconded the motion, both gentlemen speaking strongly of the painstaking labor which had been devoted to the work. It represented not the result of a few hours in consultation, but was the outcome of many years of careful thought and much study into the needs of the Institute and the best governmental policy. After an animated discussion as to the advisability of accepting certain sections, notably those in reference to the ineligibility of associate members for the offices of president and vice-president, and the wording of the section referring to the majority vote of a quorum, the vote was called for, and the constitution declared adopted, there being only three dissenting voices among the members present.

The reading of the paper of the evening then took place, the subject of which was "The New Edison Storage Battery," by Dr. Arthur E. Kennelly. This paper is reprinted elsewhere in this issue. During the reading of the paper samples of the plates of the battery were passed around among the members, and at the conclusion Dr. Kennelly showed a number of lantern slides on the screen, which illustrated the details of construction. Some curves were also shown, which brought out certain peculiar points of the battery. The discharge curves gave a very sharp "knee" near the end of the discharge, the voltage falling off very rapidly at this point. Taking the voltage over the entire range the average result was 1.1 volts, while by stopping before the "knee," that is, a short time before the battery was completely discharged, the average voltage was 1.2. With a quick discharge this battery gives no less in ampere-hours but less in watt-hours. In summing up the paper, Dr. Kennelly pointed out this new use of steel, a metal which has done so much towards the advancement of civilization, and paid a tribute to Mr. Edison's great perseverance in investigation, which resulted in overcoming the difficulty of finding a salt of iron applicable to this purpose which would not deteriorate or become soluble in the electrolyte.

In opening the discussion, Dr. Keith pointed out that there seemed to be great danger of local action between the carbon and nickel, and the carbon and iron, and he objected in moderate terms to the implied simplicity of the chemical reactions. The transfer of oxygen between the plates must entail much more complicated conditions than is borne out by the wording of the paper. Mr. Steinmetz said that storage batteries are all right when large weight is no objection and careful attention was possible. He also spoke of the complication of chemical formulæ in the lead cell and the undoubted similarity in reactions in the nickel-steel cell. President Hering asked if there would not be corroding action at the surface of the liquid where it comes in contact with the plate and perhaps necessitate floating oil on the top of the electrolyte. Later in the discussion he asked as to the effect of high-charging current. In answering, Dr. Kennelly said he did not have at his disposal any data from which satisfactory conclusions could be drawn. Mr. C. O. Mailloux pointed out the importance of what is known as "coefficient of drop and restitution," and Dr. S. S. Wheeler inquired what the remedy would be in service for the large drop. Mr. Justus B. Entz said that he had done much work in alkaline cells, but had never been able to produce an oxide of iron which was not soluble in the solution. He thought that, unlike a lead battery where the transference of active material from one plate to another is of no great detriment to the battery, in this cell the two plates being composed of entirely different substances, local action must ensue if any of the material should be carried over from one plate to the other, and this local action would continue indefinitely, resulting in great injury.

Mr. C. J. Reed spoke of similar cells with which he had been experimenting, and pointed out the advantages of having the plates near together with the corresponding decrease in resistance. He mentioned possibilities of increasing the output by thermal action and the difference between the lead and the nickel-steel accumulator in producing by the discharge a non-conductor instead of a conductor. The great desideratum of the storage battery is mechanical strength, and freedom from deterioration, and it was asked whether the presence of graphite would not produce local action as well as other deleterious results, and if the iron would not deteriorate in time. It was also asked if the cell would keep its voltage when standing, and what the effect of impurities in the electrolyte would be.

Many questions were asked as to the weight of the battery per kilowatt, the chemical action of the nickel on the steel briquettes, etc. Dr. Kennelly, in speaking of the danger of local action between the graphite and the metallic substances in the briquettes stated that the graphite seems to be normally inert, but may become active on a heavy charge. No matter what are the actual salts formed, we know that there is more oxygen, etc., on the positive plate charged than when discharged. The complete chemical formula is, of course, impossible to give, as the actual composition of the so-called nickel superoxide and iron oxide is not known, although assumed in the case of the former to be NiO_2. When discharged this superoxide, NiO_2, may become Ni_2O_3. The voltage fall of the cell is due to superficial action on the briquette and not to local action; and, of course, if the solution is not pure trouble will result.

At the close of the discussion the retiring president, Mr. Hering, in a few well-chosen words thanked the Institute for its support during his term of holding the executive office, and particularly expressed his gratitude to the committees for their aid and efficient work in carrying on the many difficult undertakings which have marked the year's history of the society. The tellers' report on the balloting for officers was then read, and the following officers were declared elected:

PRESIDENT: Charles Proteus Steinmetz, Schenectady, N. Y.

VICE-PRESIDENTS: Professor Samuel Sheldon, Brooklyn Polytechnic Institute; Professor George F. Sever, Columbia University; Professor M. I. Pupin, Columbia University.

MANAGERS: Professor W. E. Goldsborough, Purdue University; Charles F. Scott, Pittsburg, Pa.; John W. Lieb, Jr., New York City; Captain Samuel Reber, U. S. Army.

SECRETARY: Ralph W. Pope, New York City.

TREASURER: George A. Hamilton, New York City.

Before the motion to adjourn was carried the president-elect, Mr. Charles Proteous Steinmetz, in his felicitous style, addressed the members present, and said that he would do all in his power to keep up the standard set by the retiring president, and to deserve the trust put in him by the Institute.

Features of the Report of Patent Commissioner.

In the last annual report of the Commissioner of Patents some interesting facts are given. From a comparative statement of the business of the office from the years 1837 to 1900, inclusive, it appears that caveats are declining in favor. The number of applications has been growing less since the year 1868, when the highest number (3705) were taken out. In 1900 the number was 1731, the rate of decline since 1868 being quite steady. A particularly interesting part of the report is the list of names of inventors to whom more than 100 patents have been issued between the years 1872 and 1900. The list is headed by Thomas A. Edison with 742 patents to his credit. Other well-known names in the list, with the number of patents taken out by each, are: Elihu Thomson, 444; Charles E. Scribner, 374; Edward Weston, 280; Rudolph M. Hunter, 276; Charles J. Van Depoele, 245; George Westinghouse, 239; Sydney H. Short, 178; Rudolf Eickemeyer, 171; Milo G. Kellogg, 159; Hiram S. Maxim, 146; George D. Burton, 144; Elmer A. Sperry, 132, and James F. McElroy, 121. There are 39 names in the list, of which 14 are well-known electrical inventors.

Electrical Development at Manchester, N. H.

A SINGLE sub-station in Manchester, N. H., receives electrical energy from five generating plants and distributes it in four different towns. This novel condition has been made possible by the consolidation of all the electrical supply interests of Manchester and vicinity.

The importance of these interests is evident from the fact that about 30,000 incandescent lamps, 1200 arc lamps, 1500 horse-power in stationary motors, and 68 electric cars, running over 28 miles of track, are operated by the present system. All of the generating plants and distribution equipment employed for these several kinds of service are owned by the Manchester Traction, Light & Power Company, a New Hampshire corporation with a capital stock of $1,500,000. Mr. J. Brodie Smith, the moving spirit in the consolidation of electrical interests at Manchester, is the general manager of this corporation.

Like the electrical industry, as a whole, the great system here described has come up from very small beginnings. Electric lighting began in Manchester in 1882, with six Weston arc dynamos of 10 lamps capacity each. These dynamos were driven by power rented of the Amoskeag Manufacturing Company, and were devoted to commercial lighting. The lamps were of the short arc type, taking about 25 volts and 20 amperes. In 1884 a contract was made with the city to supply 10 arc lamps for street lighting, and in 1888 this number was increased to 250. About 1886 the Electric Company moved its plant to what is known as the Brook Street station, which was operated then as now by steam power.

In 1890, the Union Electric Company was formed to build a dam and electric power station at Kelley's falls on the Piscataquog River, about three miles west of the Brook Street station. This second company and all of its equipment was absorbed by the Manchester Electric Company, or the one operating the Brook Street station in 1894. In this same year the Union Electric Company had acquired a water power site at Gregg's Falls on the river just named, and about six miles from the Brook Street station.

An electric street railway was started at Manchester in 1895, and has now come to include 28 miles of single track, laid with 56, 60, 70 and 90-lb. T and girder rails, over which 68 cars are operated. Energy to operate the street railway has been supplied from the start by 500-volt generators devoted to that purpose at the Brook Street station.

Coincident in time with the later electrical developments at Manchester, two water power stations for electric lighting were started on the banks of the Merrimac River some miles to the north. One of these stations is in the town of Hooksett, 10 miles from Manchester, and the other at Garvin's Falls, four miles further up the river. At Hooksett the electric plant was originally started for local use, and the dynamos at Garvin's Falls supplied light to the village and mills of Suncook.

The Manchester Traction, Light & Power Company has been formed to own and operate all of the water-power plants, electric stations and systems just named, and much advantage and further development is expected from the unity of management thus attained. The four water-power stations named have capacities far greater than can be utilized in their respective localities, and the great bulk of the energy developed by them, as well as much of that generated at the Brook Street station, is delivered to a sub-station about 150 ft. distant from this Brook Street plant. Through the use of this sub-station energy developed at any one of the five generating plants can be delivered at any of the others, or the energy from all plants can be supplied to the distribution lines centering at the sub-station.

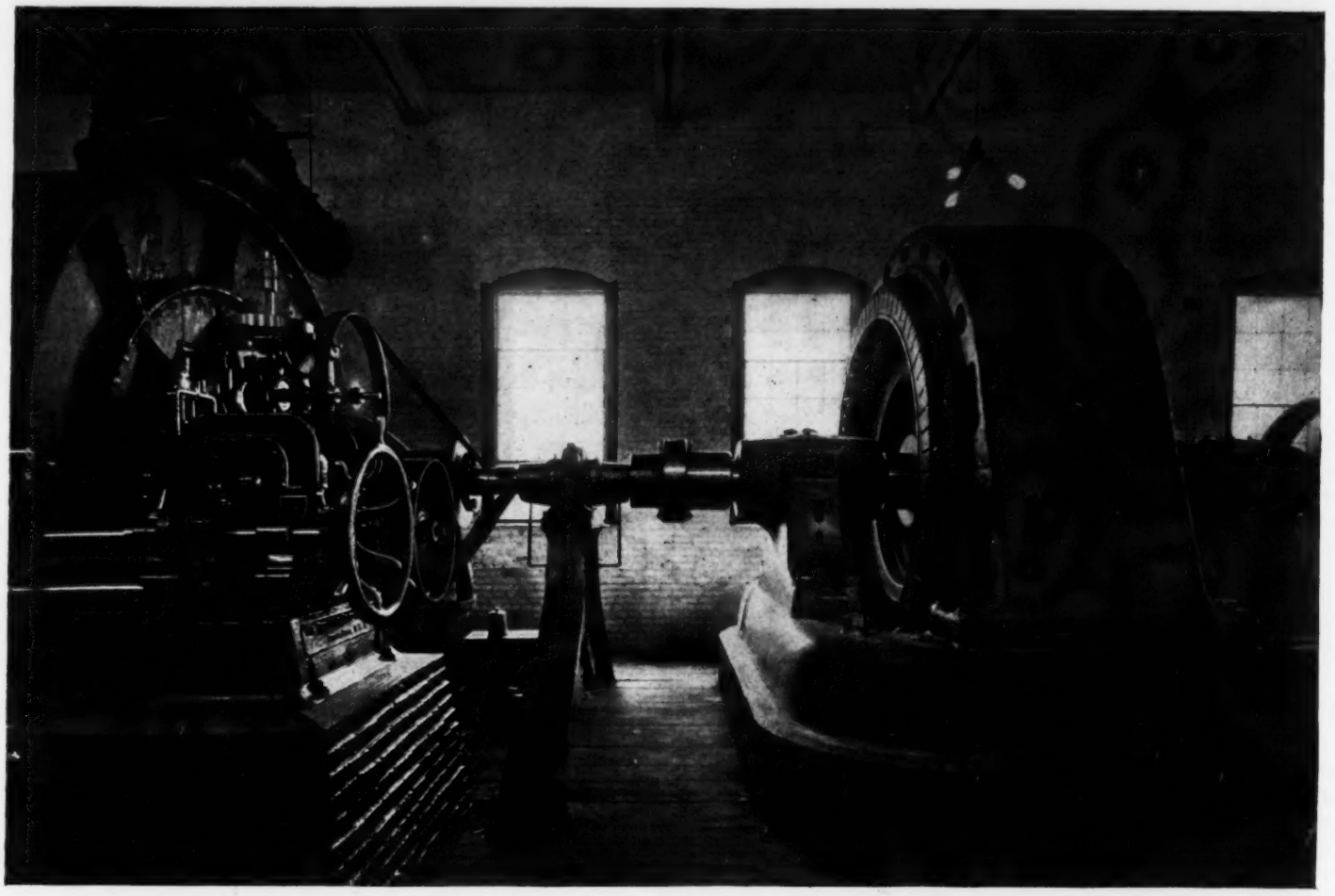


FIG. 1.—1200-KW THREE-PHASE GENERATOR, GREGG'S FALLS.

In Fig. 2 are shown the relative positions of the city of Manchester, the several towns supplied with light, and of the five generating plants and the sub-station, which gives some idea of the rather unusual problem that is being solved by this system. To bring out the conditions of the problem more clearly the several elements of the system will be taken up under separate headings.

STEAM POWER PLANTS.

The Brook Street station, not far from the center of the city of Manchester, on a spur track of the railway, and near the Merrimac River, depends entirely on steam power. The station contains two rooms, one 120 by 40 ft., the other 140 by 50 ft. Here are located 12 tubular boilers of 125 nominal horse-power capacity each, though

capable of working up to fully 2500 horse-power, as they have been required to do at times in the past. George's Creek coal is burned under these boilers, and they evaporate about 9 lbs. of water per pound of coal burned, the boiler feed being heated by engine exhaust to 160 degs. The boilers deliver steam at 115 lbs. gauge pressure, and the water for them is pumped directly from the river. Two brick chimneys furnish natural draft. The engines at this plant include one 1200-hp Providence-Green cross compound, one 800-hp Philadelphia-Green tandem compound, and two Woodbury tandem compounds, one of 400 and the other of 600-hp capacity. This makes a total of 3000 nominal horse-power. All of the engines are supplied with individual condensers and exhaust into a vacuum of 3 lbs. absolute pressure. Water for the condensers is pumped from the river, and its only cost is the expense of pumping. One of these engines is belted directly to a railway generator; the others all drive onto countershafts.

The only other steam plant included in the system of the Manchester Traction, Light & Power Company is that which supplements the

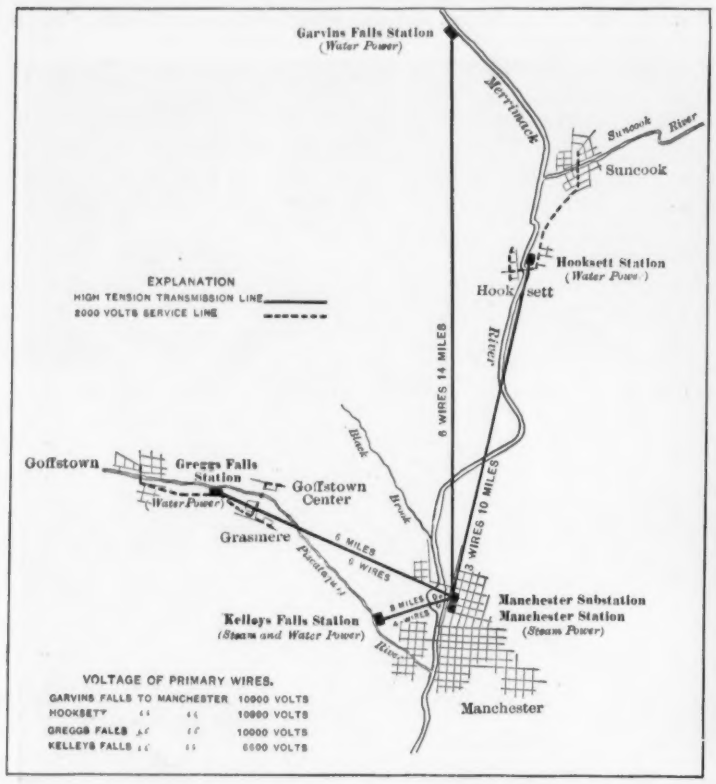


FIG. 2.—MAP OF STATION AND TRANSMISSION.

water power at Kelley's Falls. A brick dynamo and engine room one story high and 125 by 65 ft., also a two-story boiler house, 40 by 40 ft., make up the station at Kelley's Falls. In the boiler house are three upright Manning tubular boilers, each 5 ft. in diameter, 15 ft. high and rated at 200 horse-power. An iron stack 5 ft. in diameter and 80 ft. high furnishes natural draft for these boilers. George's Creek coal is burned. This station being directly on the river bank, water for boilers and condensers is readily pumped from it.

There are two engines at this plant, one 14 by 28 by 18-inch Stearns vertical compound, and one 18 by 30 by 16-inch vertical Westinghouse compound. Each engine is provided with a Bulkley condenser. A line of 6-inch shafting is driven with belts, by either or both of these engines, and the dynamos make belt connections with it.

WATER POWERS.

The four water powers of the Manchester Traction, Light & Power Company probably represent a greater combined capacity than that owned by any other electric company in New England. At Kelley's Falls the company owns the exclusive water privilege on both sides of the Piscataquog River, which has been improved by the erection of a timber dam, stone filled, and with masonry wings. The entire flow of the river has a fall of 24 ft. at this point. Two Rodney Hunt horizontal turbine wheels, each 33 inches in diameter, are fed through an 11-ft. diameter steel penstock. About 1000 horse-power is thus developed with only a fraction of the water available at most times of year. These turbine wheels are arranged to drive the shaft previously mentioned, so that either water or steam power may be applied to the dynamos. The steam power is only used at times of low water. At Gregg's Falls, three miles further up the river just named, the company has erected another stone and timber dam, with masonry wings, and owns the entire water privilege.

The stream falls 51 ft. at this point, and is estimated to yield 3000 horse-power, with a moderately good flow of water. A one-story brick station, 89 by 32 ft., has been erected just at the foot of these falls, on a shelf of solid rock, and two steel penstocks, each 10 ft. in diameter, enter it. One of these penstocks remains unused, and the other terminates in a wheel case containing three Rodney Hunt horizontal turbine wheels, 27 inches in diameter each, and operating at 333 r. p. m. to develop about 1600 horse-power. The speed of these wheels is regulated by a Replogle governor.

To the shaft extending from the wheel case the single main generator at this station is coupled. The station is designed to allow the present generating equipment to be doubled.

Next among the water powers to be considered is that at Hooksett on the Merrimac, 10 miles from Manchester, where there is a fall of 16 ft. Already 1000 horse-power here is devoted to driving dynamos in the electric station, but more power can be had by additional development.

Four miles above Hooksett the Merrimac takes a plunge of 30 ft., at what is known as Garvin's Falls. Here the company owns 1000 acres of land, and is preparing to utilize a considerable part of the

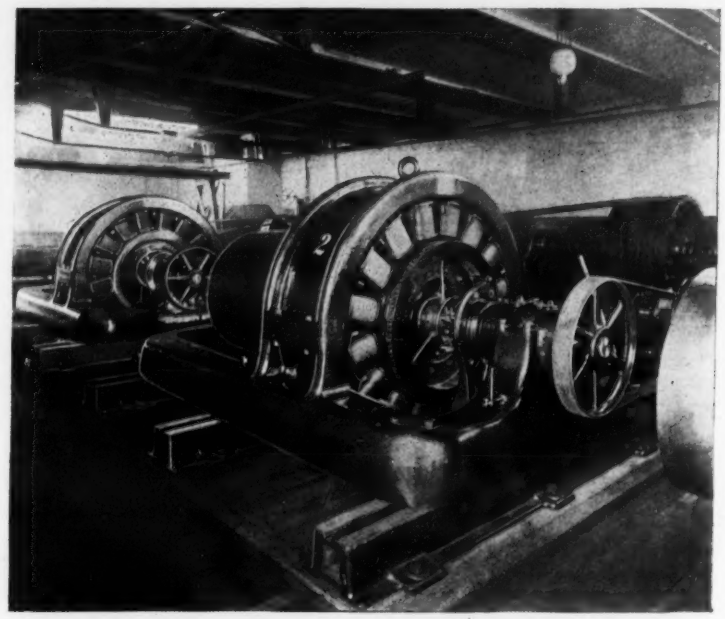


FIG. 3.—INTERIOR OF BROOK SRTEET STATION.

great power that now goes to waste. At present the Garvin's Fall electric plant requires only 350 horse-power, but contracts have already been let that call for a plant of nearly 4000 horse-power. This new plant will include a brick station with 4000 square ft. of floor space, and direct connected wheels and electric generators to the capacity of 2600 kilowatts.

To sum up for these four water-power plants, their present and partly completed equipments involved the development of about 9000 horse-power by the electrical machinery, while the capacity for future increase may easily double this figure.

GENERATING MACHINERY.

At the Brook Street station the electrical equipment includes three 600-volt generators for railway work, with capacities of 500, 300 and 200 kilowatts, respectively. Two of these generators are belt driven from the main shaft previously mentioned, and one of them is belt driven directly by its engine. All three of these railway generators deliver their energy at a switchboard in their own station, and this energy operates the electric railway previously mentioned.

At this same station are also located two direct-current, 500-volt generators for stationary motor service, one being 100 and the other 60-kw capacity. The direct-current arc light dynamos include four 125-lamp, three-circuit Brush machines, and eight 50-light, T.-H. machines, all for lamps of nominal 2000 candle-power. These are machines connected with their own switchboard in the Brook Street station, and are largely devoted to city lighting, 487 arc lamps being supplied for the streets of Manchester.

It will be noted that the three classes of dynamos just mentioned are connected to the distribution lines without passing through a sub-station. In contrast with this practice, the alternating generators at his plant deliver their energy to the switchboard in the sub-station. These alternating generators are four in number, with capacities, one of 100, two of 250 and one of 650 kilowatts, all being three-phase, 60-cycle, at 2000 volts, and of the General Electric make. The four alternating generators are belted to the main shaft which drives the railway, stationary motor, and arc dynamos, and when sending out energy are driven by the steam engines connected to this shaft. Exciters for these alternating generators are also included in the equipment.

The station at Kelley's Falls contains four alternating generators, small part of the energy to a pressure of 2000 volts to light Goffstown and Grassmere.

Two General Electric three-phase alternating generators are operated at the Hooksett station, each developing 300 kilowatts at 1000 volts. A part of the energy from these machines is distributed at 1000 volts to Hooksett and Suncook, and the remainder is raised by transformers to 10,000 volts and transmitted to the sub-station at Manchester.

At Garvin's Falls the greatest of the four water powers, four General Electric generators, direct-connected to the shafts of turbine wheels, will shortly be operating in a station now under construction. Each of these generators has a capacity of 650 kilowatts, three-phase, 60-cycle, at 10,000 volts, and is of the rotating field type. As soon as

FIG. 4.—KELLY'S FALLS.

FIG. 6.—POWER STATION AT HOOKSETT, N. H.

FIG. 5.—POWER STATION, GREGG'S FALLS.

FIG. 7.—GARVIN'S FALLS.

ELECTRICAL DEVELOPMENT AT MANCHESTER, N. H.

one 300-kw, three-phase, 2000-volt machine of General Electric make, one 450-kw, two-phase, 2000-volt, and one 180-kw, two-phase, 2000-volt Stanley machine, and one 160-kw, two-phase, 2000-volt Westinghouse generator. These alternators and their exciters are belt-driven from the main shaft, and connected through a marble switchboard 30 ft. in length. From this switchboard connections are made to transformers in the same station, which raise the energy to a pressure of 6600 volts for transmission to the sub-station, three miles away.

At Gregg's Falls there is a single General Electric alternating generator, with exciter direct connected to the turbine shaft. This generator is of the rotating field type and 1200-kw capacity, three-phase, 60-cycle, at 10,000 volts. After passing to the switchboard most of the energy from this machine is transmitted to the sub-station in Manchester. Transformers at the Gregg's Falls plant reduce a

erected, the four dynamos at Garvin's Falls will be connected by a line 14 miles long with the Manchester sub-station.

THE SUB-STATION.

From the foregoing it is seen that the system under consideration includes five generating stations; one operated entirely by steam power, one by steam and water combined, and three by water-power alone. It is desired that all of these stations deliver the greater portion of their energy for use on distribution lines in the city of Manchester, and also that each station may draw energy from any of the others at times when its machinery is not in operation. To accomplish these results energy from all the stations must be available at a common point for regulation and transfer, and this point is established in the Manchester sub-station.

This sub-station is located about 150 ft. from the Brook Street station, is one story high, 42 by 73 ft. on the ground, and is built

entirely of brick, stone, cement and iron. Underneath the main floor there is an air-tight basement which is intended to serve as an air-pressure chamber. Two blowers, each driven by a three-phase motor direct connected, are provided to maintain the air in the basement at a higher pressure than that outside. Over openings in the main floor the necessary transformers to receive the lines from generating stations are placed. These transformers are of the General Electric make and type, adapted to be air cooled, and the excess of pressure maintained in the basement causes a rapid flow of air through them. Besides the transformers the main apparatus in the sub-station is the switchboard and its equipment, designed by Hollis French and Allen Hubbard, consulting engineers, of Boston, Mass.

This switchboard deserves particular attention because of its size, construction and the rather novel service it performs. The length of the switchboard is 56 ft., its height 7.5 ft., and it is composed of two parts, duplicates as to length and height, one part being 2 ft. and the other 6 ft. 8 inches from the side wall of the sub-station. Marble set in a wooden frame is the material used for the switchboard, the wood being so prepared as to be practically incombustible. Wood was preferred to steel for this frame because it does not increase the danger with high voltages. The front part of the switchboard, or that further from the wall, is divided into 13 panels (Fig. 8), each panel being provided with instruments for a particular purpose.

Lines from the water-power stations terminate in transformers at the sub-station, and the pressures are reduced from 6600 and 10,000 volts to 2000 volts on the transformer secondaries. These secondaries and also wires from the four 2000-volt alternating generators in the Brook Street station, are run to the rear half of the switchboard, or that nearer the wall. All distribution circuits also leave this rear part of the board. Series and potential transformers for each circuit are mounted on the rear board, and circuits are carried thence to the front part of the switchboard.

Three-phase alternating currents of 60-cycles, at 2000 volts, are thus supplied by all main circuits feeding the board. To distribute

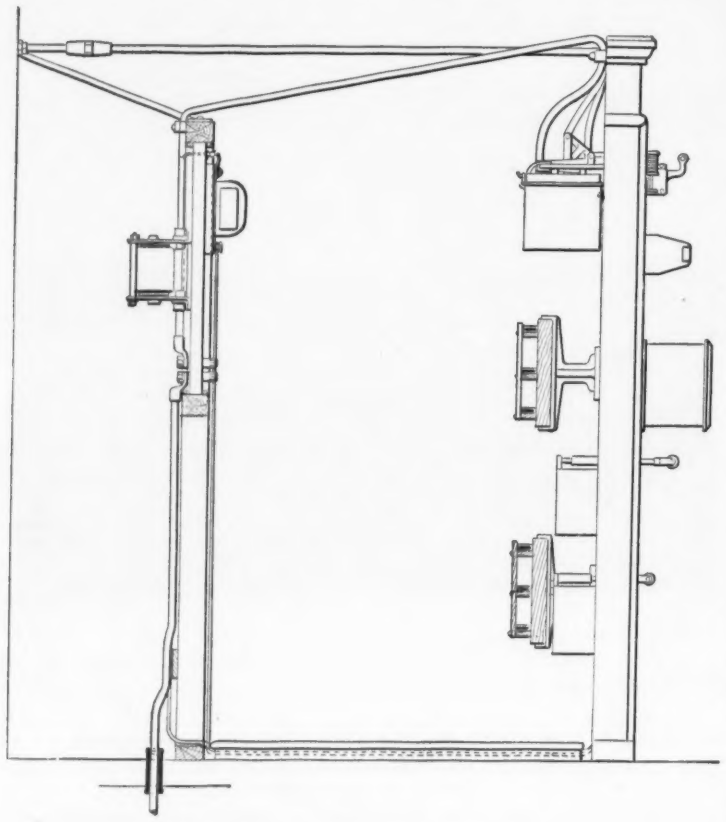


FIG. 8.—SWITCHBOARD IN SUB-STATION.

this energy to the various supply circuits, the front board is provided with two sets of three conductor bus-bars. The lower set is divided by switches into nearly as many sections as there are panels in the board, and the upper set is divided into two sections. Triple-pole, single-throw oil switches are provided to unite the sections of each set of bus-bars when desired. Each main circuit conveying energy either to or from the board is provided on the front half with a triple-pole, double throw oil switch, so that it may be connected to either the upper or the lower set of bus-bars.

In addition to this switch, each main circuit from the sub-station transformers, or from the alternating generators in the Brook Street station, is provided on the front half of the board with an automatic overload, oil circuit-breaker, an indicating wattmeter, a polyphase recording wattmeter, and an alternating-current voltmeter. Each main distribution circuit running from the board has besides the switch an automatic, overload, oil circuit-breaker, three alternating-current ammeters, and a polyphase recording wattmeter.

Both the field and armature circuits of the alternating generators in the Brook Street station, also the circuit and instruments for their exciters, are brought to the switchboard in the sub-station. The switchboard is also provided with synchronizing switches and

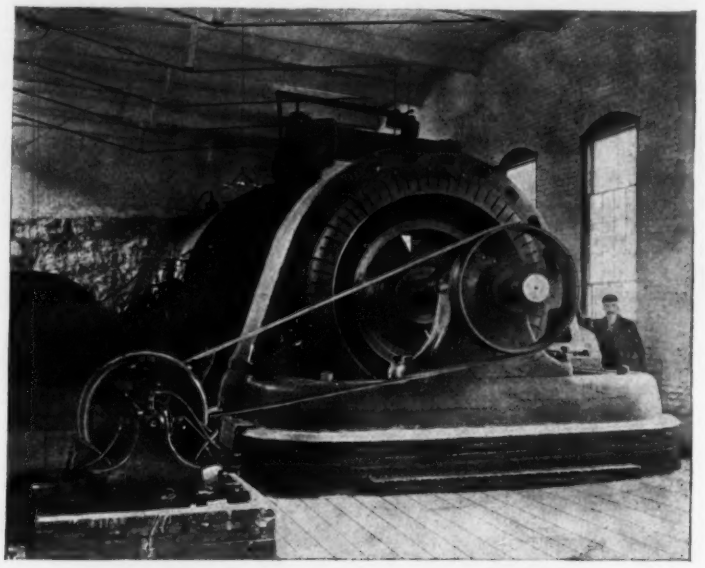


FIG. 9.—1200-KW THREE-PHASE GENERATOR, GREGG'S FALLS.

lamps, ground detector and instruments and connections for the sub-station lamps and blower motors. S. B. Condit, Jr., & Co., of Boston, were the contractors for this board.

OPERATION.

Under normal conditions the four water-power stations and the steam power station on Brook Street all deliver energy in the form of alternating currents to the sub-station. Through the transformers there the pressure of energy from the water-power plants is reduced, so that it reaches the switchboard, in common with the energy from the alternating generators in the Brook Street station, as three-phase, 60-cycle currents of about 2000 volts pressure. As each main line from generators or transformers to the switchboard terminates there in a triple-pole, double-throw switch, connecting with either the upper or lower bus-bars, and as the lower set of bus-bars can be divided by switches into as many sections as there are main supply lines from generators and transformers, each of these main lines may be connected in multiple with other similar lines on the upper set of bus-bars, or may be put onto an isolated bus-bar section of the lower set.

Each main distribution line coming to the switchboard terminates there in one of the triple-pole, double-throw switches, and may be connected through this switch either to the upper set of bus-bars or to one of the sections of the lower set. Each section of the lower set of bus-bars that connects with the switch of a supply line from a generator or transformer, also connects with the switch of a distribution line. As switches are provided that may be used to unite any or all of the sections of the lower set of bus-bars consecutively, a single main supply line may be connected to a number of these sections. The utility of these arrangements of upper and lower bus-bars and switches is that any particular transformer or generator may be devoted to the supply of certain distribution lines. In this way the pressure losses in different distribution lines may be compensated for by the connection of each distribution line to that set of bus-bars or to that section of a set, having a pressure that most nearly equals the sum of the loss in it and of the constant pressure desired at the transformers of consumers.

As the distribution service from the sub-station includes three-phase induction motors of large capacities, one of the Manchester mills supplied using 400 horse-power, and another 1200 horse-power of these motors, the loads on some of the distribution lines are subject to rapid and large variations. It is often undesirable to allow

such variations to occur in the loads on transformers or generators that are supplying circuits for commercial lighting, because of the resulting fluctuations of pressure at lamps. The sections of the lower set of bus-bars allow one or more transformers or alternating generators at any time to be devoted exclusively to one or more of these variable loads, thus avoiding its undesirable effect if connected to the general distribution system.

Obviously the arrangement of bus-bars and switches mentioned makes it possible to operate all of the generating stations in parallel on the alternating distribution lines, through the sub-station, or to supply any particular distribution line from either station. It is also possible to operate the local service from any water-power station, as that at Hooksett and Suncook, by energy from any one or from all of the other stations, when the generators at the station from which the local service starts are shut down. This result is reached through the transformers in the sub-station, which may be employed to draw energy from either set or section of the bus-bars at 2000 volts, and to deliver it to the transmission line running from the sub-station to the non-operative water-power station at 10,000 or 6600 volts, as the case may be. At this water-power station the energy from the sub-station is then reduced in pressure by transformers to 2000 volts for the local distribution lines.

The equipment and methods of operation outlined make it possible to supply the entire alternating-current load of the Manchester system from the four water-power plants, provided that these plants have sufficient capacity, which will be the case as soon as the 2600-kw station at Garvin's Falls is started. It is also desirable to operate the load of street railway motors, direct-current stationary motors, and direct-current arc lamps by the several water powers. These loads are now carried by machines in the steam power Brook Street station previously named, and with a capacity of 1000 kilowatts in railway generators, 160 kilowatts in 500 generators for stationary motors, and of 900, 2000-cp arc lamp capacity, or about 450 kilowatts, in direct-current arc dynamos, making a total of 1610 kilowatts.

After the plant at Garvin's Falls is completed so as to give sufficient capacity, the just mentioned machinery at the Brook Street station will also be operated by water power to a large extent if not entirely.

As previously mentioned, all of the electric generators at the Brook Street station, except one railway dynamo, are belt driven from the main shafting. Among the generators thus driven are four 2000-volt three-phase alternators, previously mentioned, which have a combined capacity of 1250 kilowatts. These three-phase machines can, of course, operate either as generators or as motors, and when used as motors they are capable of driving the main shafting and nearly all of the direct-current dynamos at the Brook Street station, except the single railway generator now belt-connected to an independent engine. These alternating machines, being connected to triple-pole, double-throw switches on the switchboard in the sub-station, may be supplied with current from either set of bus-bars, and thus drive the other dynamos connected to their shaft, as soon as the combined water-power capacity is great enough to carry the entire load.

LINES.

Apart from the distribution circuits in the city of Manchester and in the several towns served, the system of the company includes more than 33 miles of pole line for transmission wires. Double petticoat glass insulators are now used on all of the 6600 and 10,000-volt lines, glass having proved more reliable than porcelain for the purpose. The wires of all the high-pressure transmission lines are bare copper, it being thought that the glass insulators alone should be relied on for such voltages. Where the transmission lines pass through the city, on their way to the sub-station, they are carried above all other wires, to prevent accidents by crosses with broken circuits. Distribution lines in Manchester and in the towns served for the street railway, the 2000-volt alternating current, the 500-volt stationary motors and the direct-current arcs, are all weather-proof wire.

The collection of energy from these scattered water powers, and its delivery at the sub-station in Manchester, has already made the electrical interests there nearly, and in a short time will make them quite, independent of a coal supply. But this is only the beginning. Manchester is a city of manufactures, mostly carried on by steam. Many hundreds of electrical horse-power are even now sold to manufacturers there at prices that have led them to discard the steam engine. In the future, when the great resources of the the electrical system have been fully developed, the larger part of the machinery may be driven by distant waterfalls.

An Electrica Tide Indicator.

BY GRAHAME H. POWELL.

THE fire of the guns of a modern coast defense fort is affected by many conditions of wind, temperature and atmosphere, all of which must be accurately gauged and allowed for before a single shot is fired from the heavy guns constituting the armament.

With a vertical base system of range finding in use it becomes necessary to know at all times the exact height of the instrument above the level of the sea, and as this is constantly changing under the influence of the tides, means must be employed to keep the range finder operator always informed as to the height of the water that his

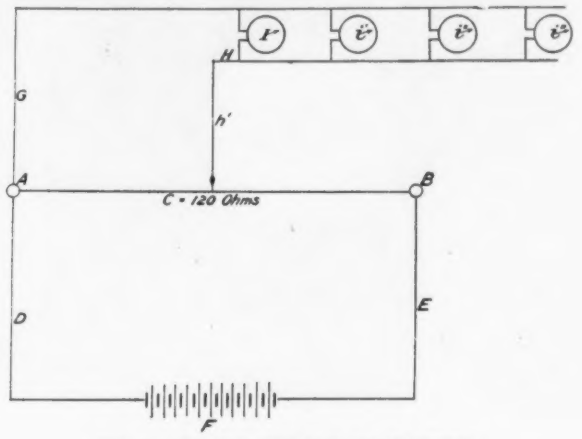


FIG. I.—SIMPLE DIAGRAM OF CIRCUITS.

instrument may be kept in adjustment, as on this depends the accuracy of the observations taken.

This has hitherto been done by means of a simple float actuating a hand on a large dial placed near the water's edge. Excursionists on boats passing through the Narrows in New York Harbor may have observed such a dial on the dock at Fort Hamilton on the Long Island shore. This dial was used as the indicator for Fort Wadsworth a mile away on Staten Island, and could only be read by means of a glass. A device recently designed and constructed by Mr. Alexis Le Blanc, an electrical engineer of New York City, overcomes all the difficulties and inconveniences of the old methods of tide-gauging.

Reference to Fig. 1 will readily show the operation of the system. *A* and *B* are two points connected to a battery *F* by means of leads *E* and *D*, the battery maintaining a difference of potential of exactly 10 volts between *A* and *B*.

Across the terminals *A* and *B* there is connected a fixed resistance *C* of 120 ohms, which completes the battery circuit. One line terminal *G* is connected to the point *A*, the other line terminal *H* to the movable slide *h'*, the indicating instruments (specially wound 10-volt voltmeters) being connected in parallel, as shown.

If the slide *h'* rests at *A* there is, of course, no difference of po-

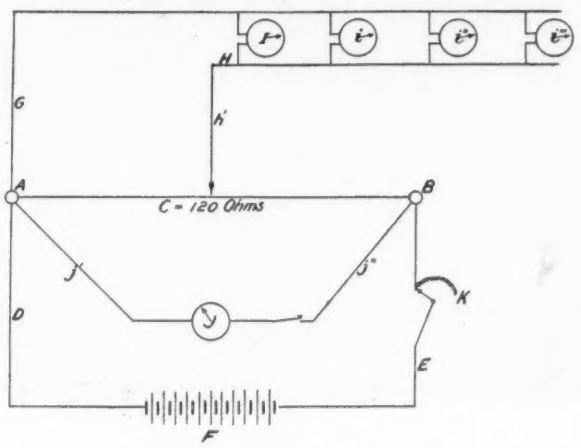


FIG. 2.—DIAGRAM OF CIRCUITS.

tential in the line circuit, and in consequence the pointers of the indicators are at rest. On the other hand, if the slide *h'* is brought in contact with *B* the full potential of 10 volts will be in the line circuit and the needles of the indicating instruments will point to the highest mark on the scale.

Taking for example the tidal conditions in New York Harbor, where there is a maximum range of 4 ft. below and 8 ft. above mean low water, a total of 12 ft., a scale was selected having 12 full divisions sub-divided into tenths, making a total of 120 lines, one for each 1-10-ft. change in level.

Assume that the slide h' is at A. Now suppose the tide to be rising and moving the slide towards B. For every one ohm resistance

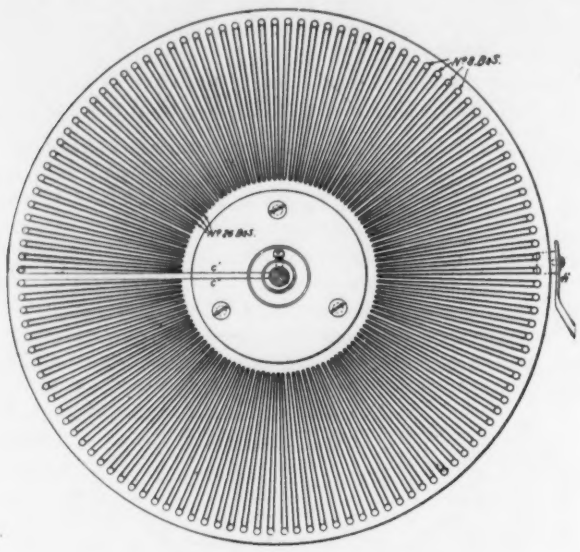


FIG. 3.—RESISTANCE DISK.

of C passed over by h' in traveling towards B the needles of the indicating instruments will show 1-10-ft. rise of tide. With a falling tide the operation is, of course, simply reversed. In order that the points A and B can be readily adjusted to 10 volts, a voltmeter J and a variable resistance K are inserted, as shown in Fig. 2.

In the actual construction of the instrument a slight variation is made from the foregoing description in that the slide h' is made stationary, while the resistance C is made to pass under it, the latter

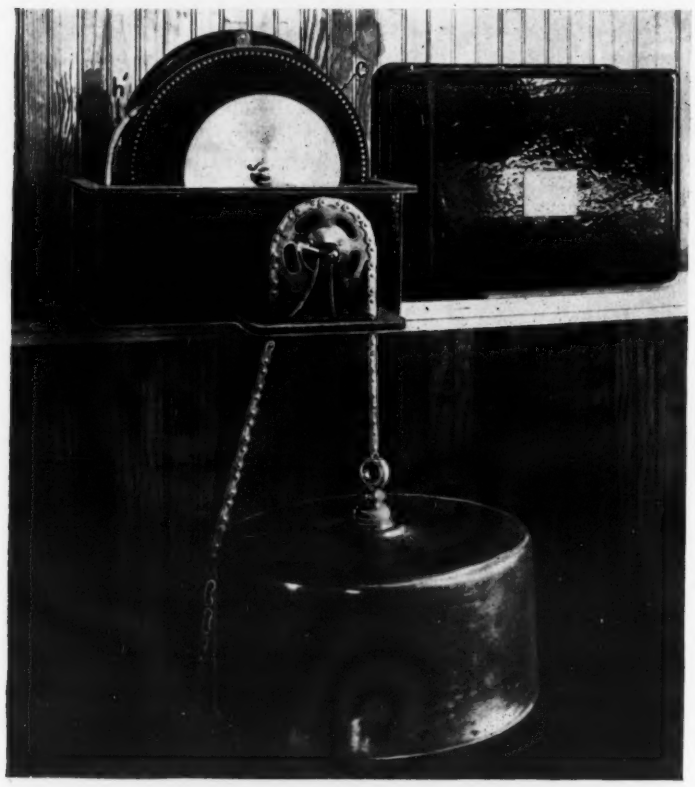


FIG. 4.—VIEW OF MECHANISM.

being embedded in a hard rubber disk (C, Fig. 4), the slide being shown as a fixed brush (h', Fig. 4).

The float, which consists of a closed copper cylinder, 12 inches in diameter and ¾ of an inch thick, has 120 copper pins inserted near its outer edge. After the pins have been inserted the disk is put in a lathe and a slot turned in its periphery just deep enough to cut away one-third the diameter of the pins, thus leaving a neat commutator surface for the brush h' to slide on. The disk is then slotted at right angles to its axis, and 120 resistance wires of exactly one ohm are looped from pin to pin around the entire circumference, except the first and last pins, which are flexibly connected to points A and B. Fig. 5. represents the indicator.

The entire apparatus is enclosed in a moisture-proof cast-iron box, the line and battery wires passing through glands

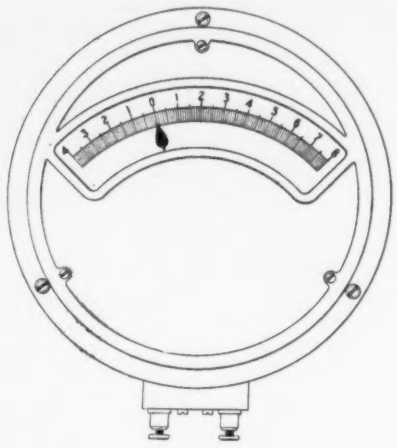


FIG. 5.—INDICATOR.

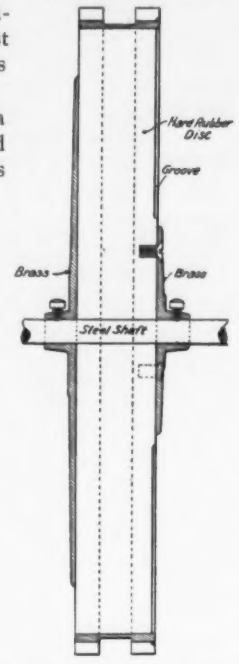


FIG. 6.—DETAILS OF APPARATUS.

packed with soft rubber. The indicators of the instrument may be placed in the several range finder houses, and thus all the operators kept constantly informed of the state of the tide, which, as before remarked, is essential to the proper working of the adopted system of vertical base range finding.

Signal Corps Work in China.

General Chaffee, commanding the American troops in China, makes hash of an article written recently by a war correspondent named Millard, depreciating in many ways the work and equipment of the American troops in China. One passage of General Chaffee's criticism is as follows: "No one objects to the high admiration expressed by Mr. Millard for the Japanese army, its equipment, etc. However, when he says, 'On the march to Pekin their field telegraph line prevented the allied army from losing connection with its base; the American Signal Corps, a branch our service is wont to boast of, did manage to string a wire and keep it open at least part of the time, being on all sorts of improvised poles in a treeless country, it naturally fell by the wayside with annoying frequency; not so with the Jap telegraph. It was provided with telescopic metal poles and braces, and when once set stood. An hour after the camp was pitched after a day's march the Japanese field telegraph would open up communication with the next station in the rear'—he is dallying with error. The fact is, the British and American telegraph line, jointly constructed and operated, was the only line brought forward with the troops."

"The Gauss."

The two Antarctic exploring expeditions which are expected to start some time in August next—the German in the Gauss, which has just been launched at Kiel, and the English in the Discovery, recently launched at Dundee—are rapidly completing their arrangements for the great undertaking. The German vessel, named after the great German authority on terrestrial magnetism, is slightly smaller than the English vessel. She is 168 ft. long and 35 ft. broad, the Discovery being 172 ft. in length at the water line and 34 ft. in breadth. It is expected that the English vessel, fully loaded, will have a displacement of about 1750 tons, whereas the Gauss will not exceed 1450 tons. Both vessels are strongly built of oak and sheathed with greenheart. The bows are made with a great sheer, so that the vessel will tend to ride upon the ice and break it with her weight. There are no openings whatever on the sides of the Discovery, all light for the cabins being obtained from the deck skylights.

Elements of Illumination—XXV.

BY DR. LOUIS BELL.

SHADES AND REFLECTORS.

AS has already been pointed out, the success of lights in common use leave much to be desired in the distribution of light, and have, for the most part, too great intrinsic brilliancy. The eye may suffer from their use, and even if this does not occur the illumination derived from them is less useful than if the intrinsic brilliancy were reduced.

Hence the frequent use of shades and reflectors in manifold forms. Properly speaking, shades are intended to modify the light by being placed between it and the eye, while reflectors are primarily designed to modify the distribution of the light rather than its intensity. Practically the two classes often merge into each other or are combined in various ways. There is, besides, a considerable class of shades of alleged decorative qualities, which neither redistribute the light in any useful manner nor shield the eye to any material degree. Most of them are hopelessly Philistine, and have no æsthetic relation to any known scheme of interior decoration. Figs. 1 and 2, a stalactite and globe, respectively, of elaborately cut glass, are excellent examples of things to be shunned. Cut glass is not at its best when viewed by transmitted light, and neither diffuses nor distributes the light to any advantage. Such fixtures logically belong with an onyx bar inlaid with silver dollars, and to that class of decoration in general almost equally bad are shades that produce a strongly streaked or mottled appearance like Figs. 3 and 4. These neither stop the glare from a too intense radiant nor render the illumination more practically useful by improving its distribution. These shades happen to be all of them for incandescent lamps, but they are evil in both principle and application, and would be equally bad in connection with any other kind of illuminant.

With open gas flames a shade may be of some use as a protection from draughts, but generally its purpose is to improve the illumination, and if it fails of this it has no excuse for being. For artistic reasons it is sometimes desirable even to reduce the illumination of a deep mellow glow quite irrespective of economy, and in such case shades may be made ornamental to any degree and of any density required, or lights may be distributed for purely decorative purposes, but gaudy spotted and striped affairs, like those just shown, are useless even for these purposes.

The first requirement of a shade is that it shall actually soften and diffuse the light it shelters. If it does not do this no amount of ornamentation can make it tolerable from an æsthetic standpoint. Almost any kind of ornamentation is permissable that does not defeat this well-defined object. Translucent porcelain, ground and etched glass are all available in graceful forms. If perfectly plain shades, like Fig. 5, seem too severe, then those finely etched in inconspicuous figures, like Figs. 6 and 7, may answer the purpose.

FIGS. 1 TO 7.—INCANDESCENT ELECTRIC LIGHT SHADES.

The main thing is to conceal the glaring incandescent filament or mantle so that it will not show offensively bright spots. Hence the general objection to cut glass which, if used at all, should for the display of its intrinsic beauty be so arranged that it can be seen by strong reflected light rather than by that which comes from its interior.

Thin paper and fabrics may be most effectively employed for shades, and can readily be made to harmonize with any style of ornamentation or color scheme that may be in hand. In this respect these materials are far preferable to glass or porcelain, although more perishable and less convenient for permanent use on a large scale. They also entail much loss of light, and are far better suited to domestic illumination than to larger installations. The real proportion of light cut off by such shades has not, to the author's knowledge, ever been accurately measured, and, indeed, by reason of the immense variety in them, it would be almost impossible to average. It is safe to say, however, that it is generally over 50 per cent, although the light is so much softened that the loss is not seriously felt in reading or other occupations not taxing the eyes evenly.

With respect to porcelain and glass shades the proportion of light absorbed has been measured many times, and on many different kinds of shades, so that actual, even if diverse, figures are available. The following table gives the general results obtained by several experimenters on the absorption of various kinds of globes, especially with reference to arc lights.

	Per cent.
Clear glass	10
Alabaster glass	15
Opaline glass	20-40
Ground glass	25-30
Opal glass	25-60
Milky glass	30-60

The great variations to which these absorptions are subject are evident enough from these figures. They mean, in the rough, that

FIGS. 8 TO 11.—SHADES AND REFLECTORS.

clean, clear glass globes absorb about 10 per cent of the light, and that opalescent glasses absorb from 15 to 60 per cent, according to their density. Too much importance should not be attached to this large absorption, since it has already been shown that in most cases, so far as useful effect is concerned, diffusion and the resulting lessening of the intrinsic brilliancy is cheaply bought even at the cost of pretty heavy loss of total luminous radiation.

The classes of shades commonly used for incandescent lamps and gas lights have been recently investigated with considerable care by Mr. W. L. Smith, to whom the author is indebted for some very interesting data on this subject.

The experiments covered more than 20 varieties of shades and reflectors, and both the absorption and the redistribution of light was investigated. One group of results obtained from 6-inch spherical globes, intended to somewhat diffuse the light without changing its distribution resulted as follows, giving figures comparable with those just quoted:

	Per cent.
Ground glass	24.4
Prismatic glass	20.7
Opal glass	32.2
Opaline glass	23.0

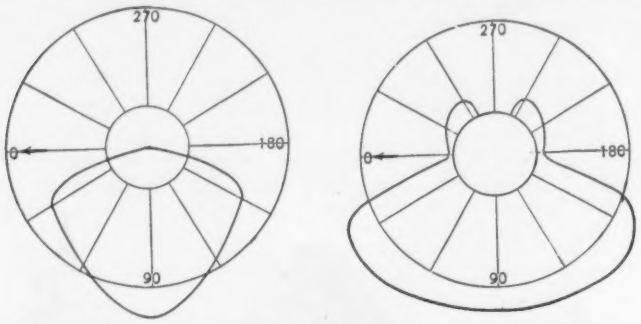
The prismatic glass globe in question was of clear glass, but with prismatic longitudinal grooves, while the opal and opaline globes were of medium density only.

Etched glass, like Figs. 6 and 7, has considerably more absorption than any of the above, being equivalent to coarse and dense grinding. Their diffusion is less homogenous than that given by ordinary grinding, so that they may fairly be said to be undesirable where efficiency is to be seriously considered.

A plain, slender canary stalactite behaved like the balls as respects distribution, and showed just the same absorption as the ground glass globe, i. e., 24.4 per cent, but permitted an offensively brilliant view of the filament within.

Another group of tests had to do with reflecting shades designed to throw light downward, in some cases giving a certain amount of transmitted light, in others really opaque. The characteristics

of some common forms of such shades are plainly shown by the curves of light distribution made with the shades in shape. Figs. 8 and 9 show two thoroughly typical examples of these shades. Fig. 8 is the ordinary enameled tin 8-inch shade, green on the outside and brilliant white within, a form too often used over desks. Fig. 9 is almost as common, being a fluted porcelain 6-inch shade, used in about the same way as Fig. 8. Figs. 12 and 13 give the respective vertical distributions produced by these two shades, the outer circles showing for reference the nominal 16-cp rating. The porcelain not only gives a more uniform reflection downwards, but transmits some useful light outwards. The case as between it and the tin shade



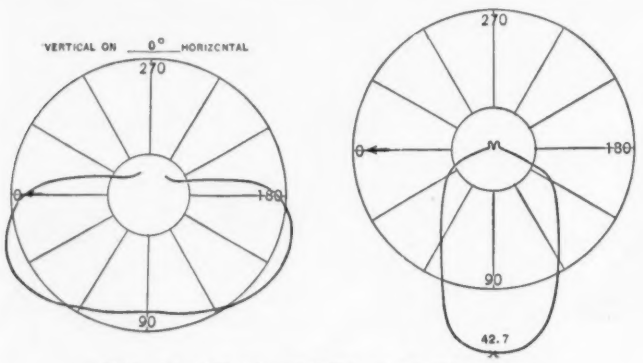
FIGS. 12 AND 13.—VERTICAL DISTRIBUTION OF TWO SHADES.

of Figs. 8 and 12, which gives a strong but narrow light downward, may be tabulated as follows:

	8-inch Tin Enameled.	6-inch Fluted Porcelain.
Mean sph'cl candle-power.....	8.12	9.89
Maximum candle-power	29.49	18.15
Horizontal candle-power	0.00	5.26
Absorption, per cent.	28.1	12.4

The absorption is, of course, based, as elsewhere, on the mean spherical candle-power. Of these two shades the porcelain one is considerably the better for practical purposes. Although it gives a somewhat smaller maximum candle-power directly below the lamp, it gives a much larger well-lighted area, and is for every reason to be preferred. The unaltered vertical distribution of an incandescent lamp is given in the curve shown in a previous article, and that curve was from the same lamp used in testing these shades.

It should be noted that the relations of these two forms would not be materially altered if they were of appropriate size and were applied to Welsbach burners the distribution of light from which, as will be presently shown, bears a rather striking resemblance to that from an incandescent lamp. The tin shade gives too much the effect



FIGS. 14 AND 15.—CURVES OF DISTRIBUTION.

of a bright spot to be really useful for most purposes. If such a concentrated beam is desired it is far better obtained by other and more perfect methods.

Figs. 10 and 11 show two other forms of reflecting shade in somewhat common use, the former to give the light a general downward direction, the latter to produce a strong and uniform downward beam. Fig. 10 is a 6-inch fluted porcelain shallow cone, while Fig. 11 is the well-known and excellent McCreary shade, 7-inch. They are intended for widely different purposes which come out clearly in the curves of distribution, Figs. 14 and 15.

The flat porcelain cone, Fig. 14, merely gathers a considerable amount of light that would ordinarily be thrown upward and scatters it outwards and downwards. It has a generally good effect in conserving the light, and whether applied to an incandescent lamp or a Welsbach deflects downward a good amount of useful illumination.

The McCreary shade, on the other hand, is deliberately intended to give a rather concentrated beam, softened, however, by the ground glass bottom of the shade. As Fig. 15 shows, it accomplishes this result quite effectively, giving a powerful and quite uniform downward beam. The annexed table shows in a striking manner the difference in the two cases:

	Flat Porcelain Cone.	McCreary.
Mean spherical candle-power....	9.84	7.50
Maximum candle-power	15.72	42.72
Horizontal candle-power	13.94	2.29
Absorption, per cent.	12.8	33.5

The small absorption in the first instance is merely due to the fact that the shade is not reached by any considerable portion of the light, while the large absorption in the later case only indicates that nearly the whole body of light is gathered by reflection, and sent out through a diffusing screen. The porcelain cone is irremediably ugly, but a less offensive shade having the same general properties may often be put to a useful purpose. The McCreary shade is purely utilitarian, but neat, and does its work well in producing a strong, directed illumination—a bit too concentrated, perhaps, for ordinary desk work, but most useful for work requiring unusually bright light. Of fancy shades modified in various ways there are a myriad, usually less good than the examples here shown.

Wireless Telegraphy in the Navy.

Admiral Bradford, Chief of the Naval Bureau of Equipment, has given out the following extract from the report of the board which has investigated the question of transmitting messages by wireless telegraphy:

From the examination of the subject as outlined in the orders of the Department the board makes the following recommendations:

1. That the use of homing pigeons be discontinued as soon as wireless telegraphy is introduced into the navy.

2. That, pending such action, no new pigeon cotes be established.

3. That wireless telegraphy be adopted by the navy for transmission of messages between distant points.

Referring to the last recommendation, the board is of the opinion that a high degree of special electrical training is demanded for the successful operation of any system of wireless telegraphy, and it therefore suggests as necessary the establishment of two stations sufficiently far removed from each other for the training officers and men. In its opinion this requirement would be best met by the establishment of such stations at the navy yard, Washington, and the Naval Academy, Annapolis.

If wireless telegraphy fulfills what now seems to be its possibilities, the cadets should be thoroughly trained in it.

As the investigation made by this board is not technical, there being no apparatus of any kind ready for test, but general in its character, such partial examinations as outlined above would not change the recommendations already made.

The selection of any special system of wireless telegraphy is, in the opinion of the board, very largely a matter of business detail.

If, for any reason, any competitive test of different systems is thought desirable, the board recommends, in view of the fact that the improved Marconi apparati will not be available for several months, and that improvements in any other systems may occur in that interval, that it be made only after due notice and preparation therefor, and by a special board of experts appointed for the purpose.

Engine Builders' Association.

The second meeting of the Engine Builders' Association of the United States will be held at the Denison Hotel. Indianapolis, Ind., on May 27 and 28. The meeting will be opened by an address of welcome by President J. E. Sweet, and the following papers will be read: "Experiences with Throttling Engines," by Professor J. B. Stanwood; "The Engine, the Heart of the Modern Building," by C. G. Armstrong; "The Relationship of Architects to the Engine Builder," by S. H. Brubaker; "Conditions and Warranties of Construction Contracts," by E. H. Burdick. On Monday evening, May 27, an informal smoker will be held in the rooms of the Commercial Club. On Tuesday evening at 8 p. m. the Association banquet will be held.

Presentation of the Latimer Clark Library to the American Institute of Electrical Engineers.

Following is the letter of Dr. Wheeler, presenting to the American Institute of Electrical Engineers the Latimer Clark library. The Council of the Institute accepted the conditions accompanying the gift:

To the Council and Members of the American Institute of Electrical Engineers:

It is my privilege to be able to announce the completion of negotiations by which I have become the possessor of the very remarkable collection of electrical books of the late Mr. Latimer Clark, of London.

My object in securing this collection was to present the books to our Institute, and make it the custodian of the most complete electrical library in the world, as well as to stimulate such interest that the Institute may in time own a permanent home in New York.

The assurances received from those who have co-operated with me in this undertaking, that the collection is very complete and includes practically every known publication in the English language previous to 1886, on Magnetism, Electricity, Galvanism, the Lodestone Mariner's Compass, etc., have been more than verified by my own examination of the books since their arrival in this country. There are among its 7000 titles many books which are not to be found in either of the famous libraries with which it has been compared, and I find that there are even some of the very earliest examples of printing.

I have always been a strong believer in the principle that every professional man is under obligation to contribute in some way to the welfare of the profession in which he is engaged, and in obedience to this idea I now desire to present this library to you complete, reserving to myself only the photographs, autographs and such duplicate books as I may add to my own collection without detracting from the completeness of the library.

As an early contributer to the Institute and one of the original members of its Building Committee, I am interested in securing for it permanent headquarters and adding to its importance, dignity and strength. It is my desire that the Institute accept the library and, through its Library Committee and a suitable librarian, administer it in such a way as to make it generally useful, and I hope that the possession of these books will add to the Institute's prestige.

I am inclined not to suggest rules for the management of the library, believing that those who are in charge from time to time are in the best position to know what is desirable, but in order to fix its general character, and secure its permanence, I condition the gift upon the acceptance by the Institute of the following provisions:

First.—The library to be kept insured against loss by fire as fully as it may be practicable to determine its value, and an annual appropriation of $1,500 to be provided for its maintenance.

Second.—A complete catalogue raisonne to be published in the name of the Institute, reciting the conditions of gift and explaining the features of interest of each book for the convenience and information of members. This catalogue to be prepared at once, and a bound copy of it to be placed in the hands of each member of the Institute.

Third.—The library to be in charge and control of a Library Board or Committee made up of members of the Institute, and not more than one-quarter of the whole number of members of this committee to be allied with any one commercial or other interest.

Fourth.—The library to remain in New York City, and to be a reference library, free to all, including non-members, and available for consultation at least three days in the week, and some evenings and some Sundays, as soon as the Institute is in permanent quarters.

Fifth.—Rare books—that is, books which it is practically impossible to replace—to be exhibited under glass with suitable explanatory cards, and to be subject to closer examination only at the library, and upon suitable introduction of the visitor to the Library Committee or their representative, the librarian, and under such other precautions as will positively assure the preservation and safety of the books.

And further, it is my earnest desire that the Institute shall, within five years, raise a sufficient fund by subscription, and provide itself with a permanent home for its meetings and library, and that this home shall be centrally located, reasonably safe from fire and not heavily mortgaged.

In case of the failure of the Institute to comply with the substance or spirit of these conditions, or with the desire expressed above for a permanent home, the library shall revert to me or my heirs or assigns.

Having in view the sole purpose of encouraging the Institute to attain the position which I feel sure all of its members desire, I have sought to name conditions easily within its reach.

SCHUYLER SKAATS WHEELER.

AMPERE, N. J., May 17, 1901.

The Latimer Clark Library.

At the annual meeting of the American Institute of Electrical Engineers held at their rooms, No. 12 West Thirty-first Street, Tuesday evening, May 21, Dr. Schuyler S. Wheeler donated to the Institute library the entire collection recently purchased by him from the executors of the estate of the late Latimer Clark, F. R. S., M. Inst. C. E., M. I. E. E., who, it will be remembered, was one of the founders of the British Society of Telegraph Engineers and became its president in the year 1875.

Reference has already been made in our columns to the extraordinary monetary value and to the extreme scarcity of many of the earlier works which have thus been secured, and we are glad to note that the appeal made in our issue of Feb. 23 last brought forth such an immediate response on the part of one of the Society's most active members. Upon learning that the Latimer Clark library was offered for sale outside of the United Kingdom, with the view to carrying out the testamentary instruction of its original owner that it should ultimately find, if possible, a suitable home in this country, and upon realizing the great benefit it would unquestionably prove to the members of the American Institute of Electrical Engineers as well as to all others likely to be interested in the early sciences, Dr. Schuyler S. Wheeler promptly entered into negotiations with the representatives of the estate and was finally successful, as already stated. But for this, the collection would, in all likelihood, have passed into the hands of agents from other countries, notably from Germany and from Japan, who had long been actively corresponding on the subject. It was, in fact, at one time Mr. Latimer Clark's avowed intention that the library should preferably go to the last-named country, in the possible event of its not finding a home in the United States, and, in a letter to Mr. P. F. Mottelay under date Feb. 21, 1898, Mr. Clark writes: "Should it fail to go to America, I would be inclined to leave it by will to Japan, a rising country, which would greatly value such an unique collection."

We have already pointed out, in a previous article, some of the rarities among the ancient works named in Mr. Clark's catalogues in order to give somewhat of an idea of the intrinsic value of Dr. Wheeler's gift, and as in our necessarily restricted space it would be difficult to do justice to the 6000 or more different entries embraced in the library proper, we regret we must now again confine ourselves to the mention of but few of such of the very early and admittedly rare works which bear a date and which are likely to whet the curiosity of those interested in magnetical and electrical literature:

1497. Pliny, C. Natural History. An exceedingly fine copy of this folio edition.

1517. "Polydori Vergilii Urbinatis de Inventoribus rerum—Libri tres."

1520. "C. J. Solini Polyhistoria." This extraordinarily rare edition contains the celebrated map of Apianus, whereon the name of America first is seen.

1541. Ptolemaii, C. "Geog. Enarrationis—libri octo . . ."

1546. Blondus, Michael Angelo. "De Ventis et Navigatione. Cum descriptione distantiae locorum a Gadibus ad novum orbem." One of the earliest tracts, 18 pages, on navigation and one of the scarcest books concerning America. It contains an engraving of a new mariner's compass, which is called "Pixis vel buxolus," from buxus, box, hence the Italian and French words *bussola* and *bussole* are derived.

1549. Affaytatus, Fortuni. "Physicae et astronomicae considerationes." Mr. Clark remarks that "Affaytatus (Affaidatus, Affaidaties) was the first to publish the declination of the magnetized needle. The credit of this has been usually ascribed to Robert Norman in his 'Newe Attractive,' 1581. George Hartman had, however, observed the phenomenon at a still earlier date." Copies of both the Norman and Hartman works are also in the library.

1555. Gesner, Conrad. "De raris et admirandis herbis . . . Et obiter de aliis etiam rebus quae in tenebris lucent."

1555. Medina, P. de. "L'arte de navegar . . . " the sixth book of which treats of the compass.

1556. Agricolae, G. "De Re Metallica."

1557. Zwingero, T. "Scrutinum magnetis physico-medicum."

1557. Cardanus, H. "De Rerum varietate." Contains many early allusions to magnetism.

1560. "Procli, in primum Euclidis Elementorum librum commentari."

1562. Ptolemacus. Geographia. Ptolemy, who wrote in the first century, originated the story of the magnetic mountains in the Indian Ocean which drew the iron nails out of ships. The earlier editions were printed before the discovery of America, which latter is not shown on the maps.

1565. Cusa, Nic. de. "Opera."

1566. Nonius, P. "Opera . . . instrumenta artis navigandi . . ."

1569. Danti, E. "Trattato dell 'uso e della fabbrica dell' astrolobio." Danti was the first manufacturer of a dial sufficiently large to correctly fix the equinoxes and solstices, and he also constructed the large dial at Florence, described by Lalande in his "Astronomie."

1571. Baccius, A. "De thermis, de aquarum natura . . . cum terris, ignibus, metallis . . ."

1572. Biringuccio, C. "La Pyrotechnie."

1599. Wright, E. "Errors in navigation." A very scarce, early, work containing a full description of the mariner's compass and its use.

1600. De Sunde (i. e., Daniel Schwenter). "Steganologia and Stegagnographia." Mr. Clark notes that "De Sunde gives a more interesting description of the magnetic telegraph than does any other writer. He calls the attention of his correspondent by ringing the bells by means of bar magnets. His needles are also moved by bar magnets, and the letters are formed by one, two or three strokes to the right or to the left, as in Cooke and Wheatstone's system."

1602. Blundeville, Thomas. "Theoriques of the seven planets . . . and descriptions of Dr. Gilbert's two instruments for seamen finding the latitude."

1609. Kepler, J. "Astronomia nova." One of the most prominent works on astronomy ever published.

1617. Stradae, F. "Prolusiones Academicae." Contains the poem on the Imaginary Lover's Telegraph, afterward translated and published in the *Spectator*, December, 1711.

1625. Carpenter, Nath. "Geography delineated forth in two bookes."

1625. Le sicur Zacani. "Livre d'Arithmétique . . . un traicté de la boussole."

1626. Leurechon, J. (i. e., Van Etten). "Récréation mathématique composée de plusieurs problêmes." The library also contains the English edition "Mathematicall Recreations," of 1633, containing, at page 104, the earliest English description and figure of the sympathetic telegraph.

1627. Fromondi, L. "Meteorologicorum, libre sex." This is the very rare first edition which is in few libraries. It is not in the British Museum, nor is it in the Ronalds collection, now belonging to the Institution of Electrical Engineers. It is stated, at page 328 of the Libri catalogue of 1861, that it is a work replete with curious information. *The pulsations of the heart, reckoned at 4450 for each hour, are employed by the author to calculate the distance of thunder.*

1632. Galilei, Galileo. "Dialogo sopra i. due sistemi del mondo Tolemaico e. Copernicano." This is the "suppressed" work which brought its author to the dungeons of the Inquisition. The library also contains Galilei's "De Systematie Mundi" of 1635, wherein, at page 88, the celebrated astronomer refers incredulously to the sympathetic telegraph.

1635. Gellibrand, Henry. "A discourse mathematical on the Variation of the Magnetic Needle, together with the admirable Diminution lately discovered." The library also contains the Berlin reprint, which was made directly from Mr. Clark's copy in 1897.

1636. Schwenter, Daniel. "Delicae Physico-Mathematicae."

1637. Servius, Petrus. "De Natura artis que miraculis."

1644. Mersenne, F. M. "Cogitata Physico-Mathematica." Contains not only a very interesting treatise on navigation, but likewise many letters from leading scientists of that period, not to be found elsewhere.

1646. Browne, Thomas. "Pseudodoxia Epidemica." This is an exceptionally fine copy of the first issue, which ran through six editions in 27 years. The library also contains the very scarce "Pseudoloxia Epidemica," edition of 1658.

1647. Arrighii, F. "Sapientiae pignus amabile philosophia universa. Treats of many sciences—astronomy, meteorology, etc.

1651. Riccioli, J. B. "Almagestum novum astronomiam."

1657. Turner, Robert. "The notary art of Solomon, showing the cabalistical key of magical operations." This is the first English writer who gives a figure of the magnetical dial.

1661. Glanvill, Josh. "The vanity of dogmatizing," also Glanvill's,

1665, "Scepsis Scientifica, or confessed ignorance the way to science," which contains, at page 149, a very interesting allusion to the imaginary magnetic telegraph.

1665. Garzoni, T. "La piazza universale di tutte le professioni del mondo . . ." As its title indicates, the author has touched upon almost everything. The work contains articles upon astronomy, alchemy, astrology, arithmetic, etc.

1684. Lanis, F. Tertius de. "Magisterium naturae et artis, opus physico-mathematicum." A veritable encyclopedia of all sciences connected with natural philosophy.

1685. Frederici, J. B. "Cryptographia." Contains, at page 234, the earliest specimen of the "Morse" code.

1694. Wilkins, J. "Mercury, or the silent and swift messenger . . ." An unusually fine copy.

1695. Hale, Sir Matthew. "Magnetisums magnus, or metaphysical and divine contemplation on the magnet or loadstone."

1696. Zahn, J. "Specula fisico-mathematico historico."

The true relative value of the Ronalds library, which has by many been hitherto considered the most prominent of all known collections of works on the early sciences, can best be established when it is stated that of all the above-named entries, but *one*, the 1635 Gellibrand, and a later copy of Stradae, the Mediolani, edition of 1626, are to be found in the catalogue issued during 1880.

Of the more modern works, dating from 1700, the collection may be considered complete. To a friend Mr. Clark wrote in January, 1897: "I have been collecting everything I could find in all languages for 47 years. . . . I, of course, in that long time (during which I kept a skilled librarian) succeeded in getting all English books, both old and new. I also got a very large quantity of all foreign works, especially the *rarer* and *older* ones. . . . In the line of pamphlets connected with early telegraphy, my collection is quite unique, and comprehends 125 volumes. . . . Although I still search catalogues, I rarely find anything that I have not got."

From the *Journal* of Proceedings of the Institution of Electrical Engineers, 1899, part 141, vol. xxviii., and from other articles, we extract the following: "The library, so far as electrical works are concerned, is unequaled. There are few if any works of importance missing. All are preserved and bound with the book-lover's conception of appropriateness and permanence, and in many cases they have valuable annotations regarding the significance of the facts disclosed in them. In this work, and in the preparation of catalogues, alphabetic and chronologic, Mr. Clark found congenial work in his leisure hours, especially of later years. The research involved gave him a rare acquaintance with the past history of electrical sciences, which found occasional expression in rectifying errors in chronology, and in giving credit where it was due. . . ."

Of the first five works picked out of the 1700 list of books exhibited upon the occasion of the opening of the library of the Society of Electrical Engineers, W. H. Preece, president, Nov. 10, 1880, *not one* of the following is to be found in the Ronalds collection:

Earl of Abercorn. "Attractive virtue of loadstones," 1729.

Swedenborg, Em. "Principia rerum naturalium," 1734. Containing a remarkable experimental treatise on magnetism.

Swaammerdam, J. "Biblia Naturali." 2 vols., 1737-8. Describing the experiments made at that early date before the Grand Duke of Tuscany as to the galvanic effect of metals, notably on the legs of the frog.

Scot's Magazine for February, 1753. Containing, at page 73, a letter by C. M., i. e., Charles Marshall, in which a real electric telegraph is for the first time invented and described.

We pass over all succeeding dates, for, in face of all that precedes and of the later works quoted in a previous article, it would be ridiculous attempting to name any particular line of modern works treating of electrical science or apparatus.

From the numerous periodicals found in the library, we select the following, representing in all some 1300 volumes: *Annales Telegraphiques, American Journal of Science, Athenaeum, Annales de L' Electricite, Annals of Philosophy, Bulletino Telegrafico, Bulletin de la Societe Int. des Electriciens, Brewster's Journal of Science, Centralblatt für Elektrotechnik, Der Elektro-Techniker, Engineer, Engineering, English Mechanic, El Electricite, Elektrotechnische Zeitschrift, Engineer and Architect's Journal, Electrician, English Mechanic, Electrical Engineer, Gehler's Physikalisches Wörterbuch, Ingénieur Electrique, El Telegrafista, Journal Telegraphique, Journal of the Telegraph, Journal of the Society of Arts, Journal of Natural Philosophy, La Nature, Lumiere Electrique.* Monthly Magazines—*Mechanics' Magazine, Nature, Naturae Novitate, Newton's Journal*

of Arts. Proceedings: Institute of Civil Engineers, Institute of Electrical Engineers, Royal Society, Physical Society, Royal Astronomical Society, etc.; *Philosophical Magazine, Philosophical Transactions, Philosophical Journal, Repertory of Arts, Repertory of Patent Inventions, Revista Telegrafica, Reports of British Association for the Advancement of Science, Scientific American, Science, Telegraphic Journal and Electrical Review, Telegrapher, Telegrafi Italiana, Zeitschrift, Angenandte Elektricitat, Zetzche Electreschen Telegrafica, Zeitschrift Telegraphen Verein.*

It is the intention of the Institute to prepare a catalogue of the library upon a much more elaborate scale than any hitherto attempted, in which the titles of all except the later and better-known works will be followed by a note giving an indication of the contents, or, in the case of the rare old volumes dealing only incidentally with electricity, the reason for their presence in an electrical library.

The New Edison Storage Battery.*

BY DR. ARTHUR E. KENNELLY.

IT is well known that the history of the storage cell is essentially that of the lead cell discovered by Plante in 1860, in which lead peroxide is the depolarizing substance. An enormous amount of labor has, in the aggregate, been expended upon the improvement of this cell in the hands of experimentalists. As a result of that labor, the storage battery has at last become a recognized adjunct to direct-current central stations, but it has limitations that seem to withstand further attempts toward improvement. Of recent years, hardly any success has been met with in the direction of reducing its weight for a given energy-storage capacity, without detriment to endurance, and this weight is the great drawback of the storage battery in electric storage traction, and has been the principal obstacle to its advance in this direction for the past 20 years.

In practice, the storage energy per unit mass of the modern lead battery, is from 4 to 6 watt-hours per pound of battery (8.8 to 13.23 watt-hours per kilogramme. Expressed in another way, a battery weighs from 124.5 to 186.5 lbs. per horse-power-hour at its terminals (75.5 to 113.4 kilos per kilowatt-hour); or, if its stored energy available at terminals were all expended in gravitational work, a battery could raise its own weight through a vertical distance of from two to three miles (3.2 to 4.8 kilometers).

While it is possible to increase the energy per unit mass by making the electrodes very light, yet this is always found to be followed by a very heavy deterioration.

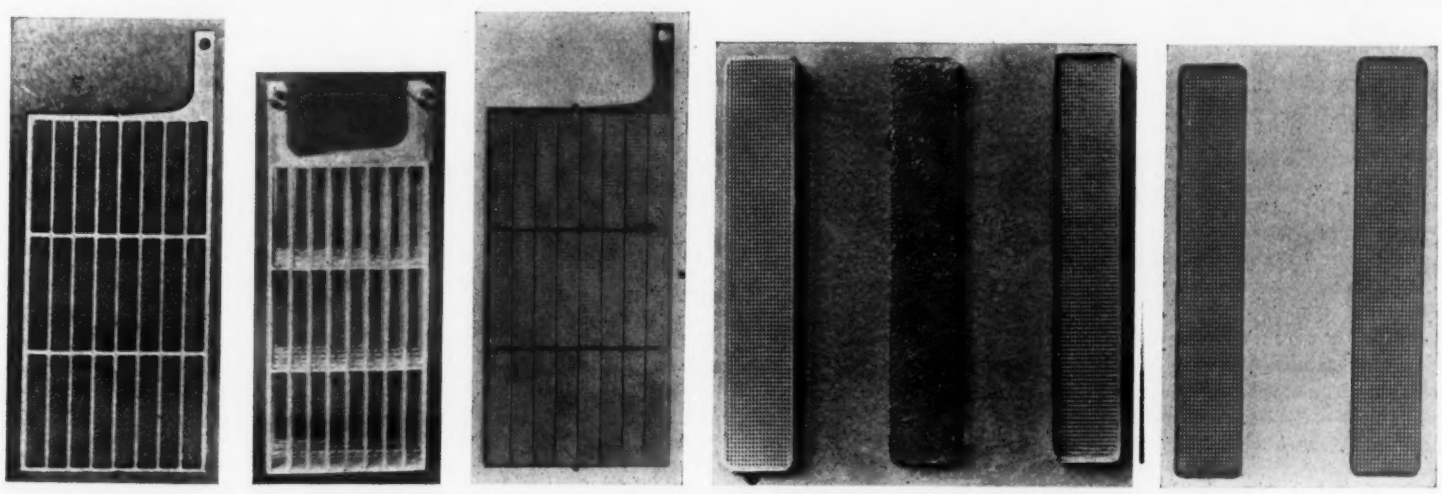
Many attempts have also been made to perfect storage cells of the alkaline-zincate type, but the great difficulty of depositing zinc in coherent form from the solution, as well as the lack of a depolarizer that shall be insoluble in the electrolyte, has stood in the way of this cell's success.

Mr. Edison set himself the task of finding a cell which should possess the following advantages:

1. Absence of deterioration by work.
2. Large storage capacity per unit of mass.
3. Capability of being rapidly charged and discharged.
4. Capability of withstanding careless treatment.
5. Inexpensiveness.

He believes that the cell here shown may claim these advantages in a very satisfactory degree. The negative pole, or positive element, corresponding to the zinc of a primary cell, or the spongy lead of a secondary cell, is iron. The positive pole or negative element, corresponding to the carbon of a primary cell, or lead peroxide of a secondary cell, is a superoxide of nickel believed to have the formula NiO_2. The cell is therefore a nickel-iron cell, a name which suggests the structural material—nickel-steel. The electrolyte is potash; viz., an aqueous solution containing from 10 to 40 per cent by weight, but preferably 20 per cent of potassium hydroxide, the freezing temperature of which is 20 degs. below zero F. or—30 degs. C.

The initial voltage of discharge after recent charge is.....1.5 volts
The mean voltage of full discharge is approximately.....1.1 volts
The normal discharging current rate per unit area of active element
(positive or negative) is .....60 milliamperes / sq. inch.
or.....8.64 amperes / sq. foot
or.....0.93 amperes / sq. decimeter.
The storage capacity of the cell per unit of total mass of the cell
is .....14 watt-hours per pound of battery
or .....30.85 watt-hours per kilo
Expressing the same statement in another way, the weight of battery per unit of electric energy at terminals is...53.3lbs. per e. h. p. hour
or.....32.4 kilos per kilowatt-hour
Or the battery gives energy at its terminals sufficient to lift its own weight through a vertical distance of approximately,
7 miles or 11.26 kilometers.
The mean normal discharging power-rate per unit mass of total cell is.....4 watts per pound or 8.82 watts per kilo
Corresponding to a normal discharge period of.....3½ hours
The cell may, however, be discharged at a relatively high rate, in approximately .....1 hour
Corresponding to a discharging power rate per unit of total cell mass of.....12 watts per pound or 26.46 watts per kilo.



FIGS. 1 TO 5.—GRIDS, BRIQUETTE AND BRIQUETTE POCKETS, EDISON STORAGE BATTERY.

Charging and discharging rates are alike. That is to say, the cell may be charged at the normal rate in 3½ hours; or, it may be charged at a relatively high rate in one hour, with no apparent detriment beyond a somewhat lowered electrical charge efficiency. In other words, the cell does not appear to be injured by overcharging or discharging, and only suffers in electrical efficiency under such treatment.

The positive and negative plates are mechanically alike, and can scarcely be distinguished by the eye. They differ only in the chemical contents of their pockets. The samples here exhibited, which are intended for automobile batteries, illustrate the construction. Each plate is formed of a comparatively thin sheet of steel, 0.024 inch (0.61 mm) in thickness, in which rectangular holes are stamped, so as to leave a grid or frame somewhat resembling a window-frame. In the plate here shown, there are three rows of eight rectangular holes or recesses, or 24 recesses in all.

Each opening or recess is filled with a pocket or shallow box containing the active material. These boxes correspond to the panes of glass in the window-frame analogy. The panes instead of being thin-

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ner than the frame, as in an actual window, are thicker than the frame, or project slightly beyond the surface of the steel grid. They are perforated with numerous small holes to admit the electrolyte, but entirely conceal the contained active material from view. All that meets the eye, therefore, in any of the plates, is the steel frame, and its embedded "windows" of perforated steel.

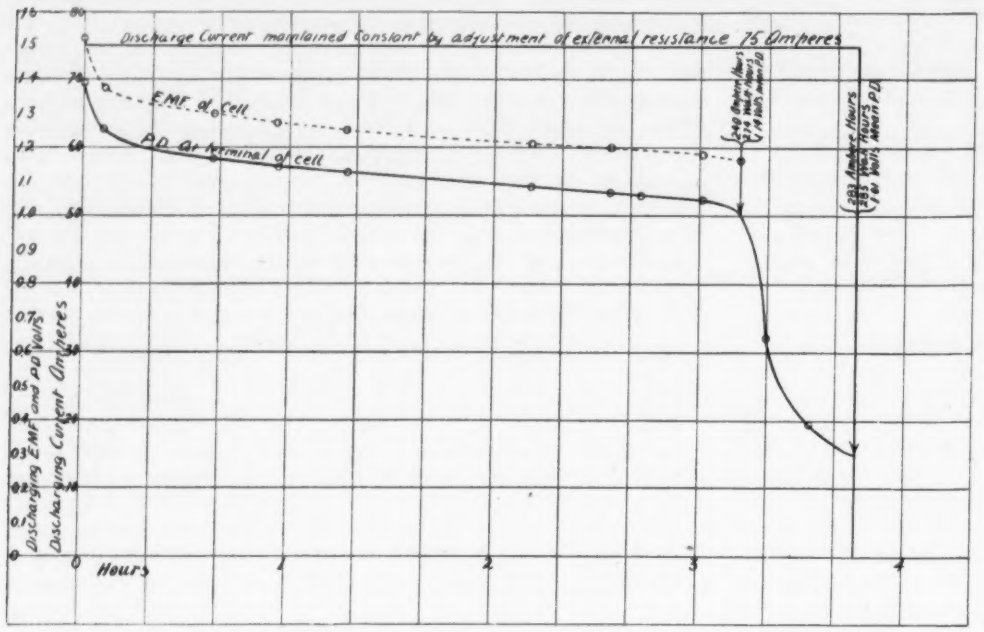


FIG. 6.—DISCHARGE CURVE OF EXPERIMENTAL CELL.

The active material is made in the form of rectangular cakes or briquettes, and one such briquette is lodged in each pocket or "window pane" of the plate. Each of the plates shown, therefore, supports, or contains, 24 briquettes of active material, all in rigid contact with its own substance.

Each briquette is placed in a shallow, closely fitting nickel-plated box of thin, perforated crucible steel, cut from a long strip of that material 0.003 inch (0.075 mm.) thick. A cover or lid of the same material is then laid over it, so that the briquette is closely enveloped by the sides and walls of its perforated steel box. The boxes are then placed in the openings or holes in the nickel-plated steel grid, and closely fit the same. The assembled plate is then placed in a hydraulic press, and subjected to a total pressure of about 100 tons. This pressure not only tightly closes the boxes, but it also forces their metal sides over the adjacent sides of the recesses in the steel grid, thus clamping the whole mass into a single solid and rigid steel plate with the hollow "window panes" full of active material. The nickel-plating of both grids and boxes aids in securing good permanent electric connections between them. The finished plate has a grid thickness of 0.024 inch (0.56 mm.), and a "window" or pocket thickness of 0.1 inch (2.5 mm.). This is the maximum thickness of the plate at any point, but being of steel, the plate has ample rigidity.

The positive briquettes (zincs of a primary cell) are made by mixing a finely divided compound of iron obtained by a special chemical process with a nearly equal volume of thin flakes of graphite. The graphite does not enter into any of the chemical actions, but assists the conductivity of the briquettes. The graphite is divided into very thin laminæ by a chemical process, and these are passed through sieves or screens so as to leave a size or area of flake that is much larger than the area of the perforation in the steel windows. The mixture is then pressed into briquettes in a mold, under a hydraulic pressure of about two tons per square inch. The briquettes have a surface area of nearly 3 inches by ½ inch on each face.

The negative briquettes (carbon of a primary cell) are made by similarly mixing a finely divided compound of nickel, obtained by special chemical means, with a nearly equal bulk of fine flakes of graphite, and solidifying the mixture in a mold into briquettes of the same size as above.

A suitable number of positive and negative plates are assembled together, being separated from one another only by a thin sheet of perforated hard rubber.

The assembled plates are placed in a vessel or external cell of sheet steel containing the potash solution, which, of course, does not attack steel. There was, however, much difficulty from the action of the potash on the soldered seams of the steel containing vessel. After many trials, however, Mr. Edison found a solder which seems to be entirely unaffected by the alkali.

In charging, the current is, of course, sent into the positive pole and its attached negative nickel-plate, through the electrolyte, and

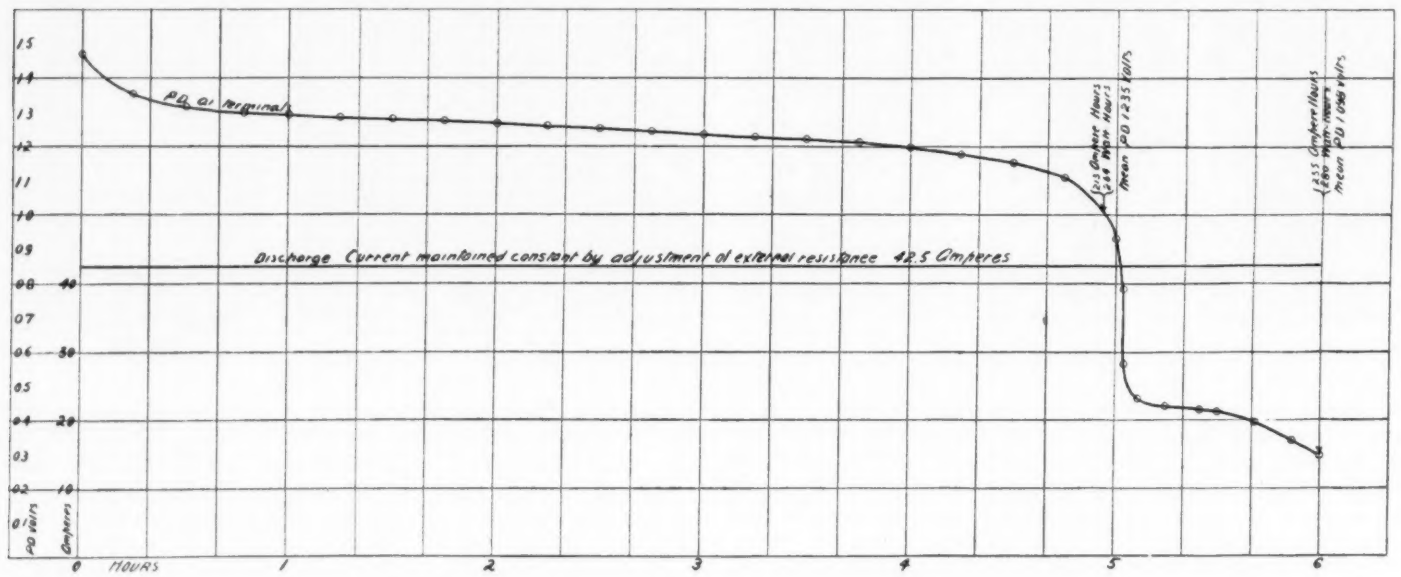


FIG. 7.—DISCHARGE CURVE OF EDISON EXPERIMENTAL STORAGE CELL.

into the positive plate of the iron compound which carries the negative pole. This current deoxidizes or reduces the compound to spongy metallic iron and carries the oxygen through the film of electrolyte to the nickel compound, oxidizing it to the superoxide of nickel $Ni\ O_2$, a higher oxide than the peroxide. In other words, the charging current simply carries oxygen in the opposite direction against the forces of chemical affinity, from the iron to the nickel, and stores the energy in the reduced iron, which is, of course, unaf-

fected and passive in the presence of the potash solution. On discharge, the current passes from the positive pole through the external circuit to the negative pole, and its attached iron or positive plate, and then through the solution to the negative or superoxide plate. In so doing the oxygen moves back against the current and partially reduces the nickel superoxide Ni O_2 while oxidizing the spongy iron. The energy of burning of the iron and oxygen which would be developed as heat in the ordinary chemical process is now liberated in the circuit as electrical energy.

The cell is an oxygen-lift. Charging pulls the oxygen away from the iron and delivers it temporarily to the nickel. The condition is then stable, until the circuit of the cell is completed. Discharge then allows the oxygen to fall back from the nickel to the iron with the natural affinity of iron and oxygen.

This action is very different from that which takes place in the lead storage cell. Here, neglecting complications, the action is usually regarded for practical purposes as being represented by the equation

$$PbO_2 + 2H_2SO_4 + Pb = 2PbSO_4 + 2H_2O \ + 100 \text{ watt-hours},$$

where the left-hand side represents the condition of charge and the right-hand side the condition of discharge. Here oxygen is not simply transferred in discharge from the peroxide to the spongy lead, but the solution is changed (theoretically) from an aqueous solution of sulphuric acid to plain water. Of course, the discharge could not practically be carried to the point of denuding the solution of all sulphuric acid, and a surplusage of acid must be used. The equation gives a mere theoretical outline of admittedly very complex reactions. In other words, the specific gravity of the sulphuric acid solution falls during the discharge, and the solution enters into the chemical combination. Theoretically, for every 445 grammes of active material on both plates, 196 grammes of sulphuric acid are required to effect the combination, or 44 per cent by weight of the active elements, and in practice it is usual to allow a weight of sulphuric acid nearly equal to half the weight of the elements, or about one-quarter of the total weight of the cell.

In the new Edison cell, on the other hand, the theoretical action of the potash solution is merely to provide the proper channel through which the oxygen ions may travel in one direction or the other—positive plate to negative plate in charge, and negative plate to positive plate in discharge. Consequently, the amount of solution needs only to be sufficient to fulfill mechanical requirements. It is believed that the weight of solution will in practice be only about 20 per cent of the plate weight or about 14 per cent of the cell weight. In fact, the cell may be worked in the same manner as the so-called primary "dry-cells." Moreover, if the solution should escape, or be carried away, by gasing in charging, the only detriment seems to be the loss of active surface thereby occasioned, and it will only be necessary to fill up the cells to the proper level with water from time to time, as evaporation or gasing may lower the level. For the same reasons the specific gravity of the electrolyte does not appreciably vary during charge and discharge.

The briquettes of active material slightly expand on receiving oxygen, and slightly contract on delivering it, that is to say, the iron briquettes contract and the nickel briquettes expand during charge, while on discharge the iron briquettes expand and the nickel briquettes contract. The level of the solution is in this way scarcely affected. The expansions and contractions of the briquettes appear to be well within the elastic limits of the spring-steel containing boxes, and consequently the electric contact is always secure. The covers or sides of the window pockets merely approach to or recede from each other slightly during charge and discharge. Fortunately, steel is the metal which possesses this mechanical elasticity in a marked degree.

The action of the charging and discharging current upon the briquettes seems to be transferred from their external surfaces inwards in a manner similar to the transfer of carbon and oxygen in the process of making malleable cast-iron in the furnace on the principle of cementation. No active material has been found to be ejected from the briquettes through the window perforations, even under the deliberate overcharging and discharging. Such gas as is thereby produced makes its appearance on the external surface of the windows.

If the nickel compound had no affinity for oxygen, so that energy was neither developed nor absorbed in the deoxidation of further oxidation of that substance, then the energy would be entirely that due to the energy of combination or oxygen and iron, stated to be 79.7 watt-hours, and representing an e. m. f., theoretically obtainable, of 1.47 volts. If the combination of oxygen with the nickel compound be exothermic or energy-releasing, then the watt-hours delivered (and the e. m. f.) will be lessened by the energy necessarily paid back to break up the combination.

If, on the other hand, the combination is endothermic or energy-absorbing, then the watt-hours delivered (and the e. m. f.) will be increased by the energy restored on breaking up the combination. Since the superoxide seems not to have been known hitherto, no information concerning its energy of combination is obtainable. The e. m. f. of the cell seems to be so near to that of the union of iron and oxygen as to suggest that the nickel superoxide is not far from being neutral, or that the nickel compound has but little affinity for oxygen, although the superoxide appears to be quite stable in the cell.

The new cell does not seem to be appreciably influenced by changes of temperature, and should stand a very low temperature without detriment. The electrolyte—potash—does not attack any of the ingredients of the cell, nor are any of the ingredients soluble therein. No local action occurs in the cell so far as has yet been observed since the e. m. f. is below that necessary to decompose water.

The cell may be fully discharged to the practical zero point of e. m. f. without detriment. In fact, a cell has not only been completely discharged, but recharged in the reverse or wrong direction, and after bringing it back to its originally charged state by proper restoration of the direction of charging current, the storage capacity remained unaffected. It would seem, therefore, that the cell should be capable of withstanding much abuse.

Diagrams are shown on screen giving the curves of discharge of experimental cells.

Mr. Edison states that "the negative plate (nickel) either charged or discharged, can be removed from a working cell, and dried in the air for a week, without appreciably injuring it, and when the plate is finally replaced in the cell its charge is practically undiminished.

The positive (iron) plate, if similarly removed from the cell will be likewise uninjured, but it soon loses its charge by the oxidation of the spongy iron with accompanying liberation of heat and appreciable rise of temperature extending over a period of several hours. On replacing the electrode, however, in the cell the storage capacity is unaffected on recharge.

As regards cost, Mr. Edison believes that after factory facilities now in course of preparation have been completed, he will be able to furnish the cells at a price per kilowatt-hour not greater than the prevailing price of lead cells.

Having now considered the action and properties of the cell, a brief description may be given of the difficulties encountered in developing it.

The phenomenon of passivity has probably kept inventors from finding this cell in the past. Mr. Edison believes that of all the very numerous compounds of iron, and of which he has tried many hundreds, the particular compound which he prepares, is perhaps the only one capable of being used in this way.

If the dried hydrates, or oxides of iron native or artificial, are subjected to electrolytic reducing action in any alkaline solution, they remain inert and unaffected.

On the other hand, if finely divided iron obtained by reducing a compound of iron under the action of a reducing agent, such as hydrogen, or carbon monoxide is subjected to electrolytic oxidation in an alkaline solution it is inert and cannot be oxidized. It assumes the well-known passive state.

The same difficulty of passivity affects the use of nickel or the negative element. Finely divided nickel, reduced from a nickel compound, remains inactive when subjected to electrolytic oxygen in an alkaline solution. The monoxide and the black-oxide or peroxide are also inert. No oxide of nickel is active or can be made active by electrolytic action, and the peroxide does not act as a depolarizer.

Trolley Automobile Line in Germany.

Consul-General Guenther, at Frankfort, says that a Berlin engineer has constructed a trolley automobile line, similar to that exhibited at the Paris Exposition, at Eberswalde, near the German capital. In this system the automobile receives its motive power from an overhead wire by means of a trolley, which is connected with the automobile by a movable cable. This allows the vehicle to turn out at any place on the road. The consul-general adds that the line has been favorably inspected by experts, and that the system is expected to meet with general favor in Germany.

Death of A. Langstaff Johnston.

THE LATE A. LANGSTAFF JOHNSTON.

We regret to announce the death of Mr. A. Langstaff Johnston, which occurred at his home in Richmond, Va., May 15. Mr. Johnston was 50 years of age on Aug. 16 last, and for the past several months has been in poor health. He is survived by his widow and four children, two sons and two daughters.

Mr. Johnston was born in Richmond, and was graduated from the Virginia Military Institute. After his graduation he was employed in the construction of the Chesapeake & Ohio Railway, and was assigned to important tunnel work, in which he acquitted himself with credit.

In 1876 he was made city engineer of Manchester, Va., where he designed and established a system of street grades, and introduced other extensive improvements. From 1870 to 1880 he was engaged as assistant engineer on river and harbor improvements with Colonel William P. Craighill, afterward chief of engineers, United States Army. In 1888 and 1889 he constructed part of the railway system of the Richmond Railway & Electric Company. His next important work was for the New Orleans & Carrollton Railway Company, for whom he built 28 miles of track. He was later appointed chief engineer of the Hestonville, Mantua & Fairmount Passenger Railway Company, for whom he supervised the electric conversion of that road. He also acted as chief engineer or constructing engineer for railway companies in Meadville, Pa., and elsewhere.

In 1896 Mr. Johnston was awarded the John Scott medal by the Franklin Institute, of Philadelphia, for a complete system of electrical railway bonding. A few months ago Mr. Johnston was urged to let his name go before the Philippine Commission for appointment in charge of electrical engineering on the islands, but this he declined. Mr. Johnston was a member of the American Institute of Electrical Engineers, of the American Society of Civil Engineers and the Franklin Institute.

CURRENT NEWS AND NOTES.

NERNST LAMPS AT HARTFORD.—The Hartford Electric Light Company promises to have the distinction of being the first electric lighting company to install Nernst lamps. The first building in which the lamps will be installed is the State House.

GLASGOW INTERNATIONAL ENGINEERING CONGRESS.—One of the nine sections of the International Engineering Congress to be held in Glasgow Sept. 3, 4, 5 and 6, will be devoted to electricity, the honorary secretary being Mr. W. G. McMillan, secretary of the British Institution of Electrical Engineers. Professor John Perry is one of the vice-presidents of the congress, and Mr. Alexander Siemens a member of the executive committee. Mr. T. C. Martin has been nominated an honorary member from the United States.

REPORTING ARRIVAL OF STEAMERS BY WIRELESS TELEGRAPH.—The New York *Herald* announces that it has been given authority by the United States Lighthouse Board to establish a wireless telegraph station on the Nantucket Shoal lightship for the primary purpose of reporting ship news. The Marconi system will be used. The plan is to establish a land station at Sankaty Head on Nantucket Island, which will be connected to the mainland by a cable to Wood's Hall, Mass., by way of Martha's Vineyard. At Sankaty Head there will be a mast 130 ft. high, and on the lightship a pole 47 ft. high will be attached to one of the masts. It is stated that steamers equipped with wireless telegraph apparatus will be enabled to report their arrival off the American coast 13 hours earlier than under the present method. It is expected that the system will be in operation by July 1 next. It is also reported from Portland, Ore., that a wireless telegraph station is to be established at the mouth of the Columbia River for the reporting of the arrival and departure of vessels. A station will also be established at the entrance of the Straits of Fuca.

PROTECTION OF ROTARY CONVERTERS.—It is well known that if the circuit of the alternating-current side of a rotary converter is broken when the field of the converter is weakened a dangerous speed may be attained by the machine operating as a direct-current motor. Now it frequently happens that it is desirable to weaken the field of the converter when in operation in order to cause the alternating-curren system to supply a lagging current at no load, which may change to a leading current under heavy loads by reason of the energizing action of the series field magnet winding. In other cases the series field magnet current may be stronger than is desired, and the shunt field magnet current will therefore be weakened correspondingly to give the desired field strength. In order to avoid difficulty arising under the above-named conditions, as well as when the field magnet circuit is interrupted, is the object of a patent issued May 14 to B. G. Lamme. The means provided consists in the employment of a circuit breaker in the shunt field, whereby the circuit of the direct-current side of the rotary will be broken when the shunt field current is reduced below the safety limit or is interrupted by the breaking of its circuit.

INTERCONNECTED ALTERNATING AND DIRECT-CURRENT DISTRIBUTION.—A patent issued May 14 to B. G. Lamme describes a system for transferring energy from an alternating to a direct-current system and vice versa, in order to accommodate changes in load in either or both systems. As illustrated, the polyphase circuit is connected with one side of a rotary converter and the direct current with the other side, the exciter of the rotary being either independently driven from the alternating-current side, or from the armature of the rotary. With this arrangement the rotary tends automatically to transfer energy from either system to the other, dependent upon the conditions of load, speed, etc., of the prime movers of the two systems. Assuming first that the alternating-current system is overloaded and drops in its speed or rate of alternations, the rotary will also drop in speed, its field will be weakened by reason of the drop in speed of the exciter, and consequently the armature of the rotary will tend to speed up and pull ahead of the alternating-current system. This is a condition for feeding energy into the alternating-current system corresponding to the case of two alternators connected in parallel. Assuming now that the direct-current system is overloaded and consequently its voltage falls off, the direct-current voltage of the rotary will tend to remain normal, since its speed is controlled by the alternating-current system, and its field constant and unaffected by the drop in the e. m. f. in the direct-current system. If both the direct and alternating systems have inherently rising e. m. f.'s with increase of load, the automatic transfer of energy may not take place in the right direction, but with falling characteristics the transfer will be such as will tend to assist the overloaded machine.

DETAILS OF ELECTROLYTIC LAMPS.—Two patents issued May 14 to A. J. Wurts relate to details of the Nernst lamp, the subject of one being an arrangement for automatically switching glowers into circuit, and the other relating to a form of heating arrangement for the glower. The first-mentioned patent describes means whereby only a single glower or single set of glowers will be in service at any one time, but if a glower or set of glowers becomes broken by accident or through long use, another will be automatically put into service to take the place of that rendered inoperative. As illustrated, for a pair of glowers three electromagnets are employed, whose windings are so connected with the glowers and with the heater circuit that if a glower shall become broken the interruption of current will de-energize two of the electromagnets and the circuits of the heater and the remaining glower will thereby be closed. As soon as the remaining glower becomes conductive the heater circuit will be interrupted by one of the magnets, and the lamp will operate as before. The second patent relates to means for making the circuits of the glowers and that of the heaters independent of each other, it having been discovered that there is danger of flashing taking place between the glowers and the heater wire when the circuits supplying these parts are connected. To this end the heaters are placed in the low-potential secondary circuits of transformers, and the glowers in a circuit of higher potential supplied by the same generator as the transformer, or by an independent generator. As illustrated, the primary of the transformer is connected across the same mains as the glower, and the heater is in the transformer secondary. In series with the glower is a solenoid. When the glower has been sufficiently heated to become conductive, the current passing through the coil of the solenoid is sufficient to draw up the core thereof and operate a switch so as to break the primary transformer circuit and thus cut out the heater.

OHIO ELECTRIC LIGHT ASSOCIATION.—The next annual meeting of the Ohio Electric Light Association will be held at Hotel Victory, Put-in-Bay, Lake Erie, on Aug. 20, 21 and 22.

FRENCH SUBMARINE CABLES.—The submarine cable which has just been laid between Marseilles and Tangiers inaugurates an elaborate system of cables by which France proposes to put herself at a cost of $25,000,000 in direct communication with her remote colonies and foreign countries. That the system can pay commercially seems impossible.

UNDERGROUND WIRES IN MONTREAL.—The question of compelling the electric companies to remove their poles and wires from the streets and place the wires underground has been under consideration in the City Council. It is stated that their charters and the contracts between the companies and the city give the city authority to compel the companies to put their wires underground, except in the case of the Montreal Street Railway Company.

TELEPHONE MILEAGE IN CANADA.—During a recent inquiry in the Dominion House of Commons as to the mileage of the Bell Telephone Company's system in Canada, the following figures, representing the length of lines in operation in the various Provinces, were given: Ontario, 53,000 miles; Quebec, 30,000 miles; Manitoba, 4000 miles, and in the Territories, 169 miles. Lines are proposed as follows: In Ontario, 5000 miles; in Quebec, 2000 miles; Manitoba, 299 miles, and in the Territories, 25 miles. The number of subscribers in Ontario is 23,000; in Quebec, 22,000; in Manitoba, 2000, and in the Territories, 302.

ENGLISH MUNICIPAL OWNERSHIP.—We are often told of the beauties of municipal ownership as exemplified at Birmingham. Mr. Labouchere, M. P., in his well-known satirical journal, has this on the subject: "Who was it that first sang the praises of Birmingham as the best-governed city in the world? The emptiness of the boast is now generally recognized, and if any doubt remained it would surely be dispelled by the graphic articles in the *Birmingham Daily Gazette* on 'Scenes in Slum-land,' which I recently mentioned, and which have since been reprinted in pamphlet form. The best-governed city in the world, forsooth! I question whether there is any town in the country where the poor are herded together amid such conditions of filth and horror, in such hotbeds of disease and immorality, as those revealed in these articles. The state of affairs which Mr. J. Cuming Walter has depicted shows that there must have been disgraceful apathy and negligence on the part of the sanitary authorities. But the public conscience of Birmingham must be dead indeed if the present exposure does not result in a radical change of municipal policy in this respect."

ASYMMETRIC CONDUCTOR.—Two forms of asymmetric conductor, of considerable theoretical interest, and differing radically in principle from those electrolytic rectifiers employing an aluminum electrode, form the subject of patents recently granted to Mr. L. W. Hildburgh, of New York City. It will be recalled that an article by Mr. Hildburgh on the subjects of these patents appeared in our issues of April 14 and 21, 1900. In each case two electrodes are used in connection with an aqueous electrolyte, one of them being polarizable for a current in a given sense, and the other not, the depolarization being effected either by immersing one electrode in a liquid capable of oxidizing hydrogen, or by providing one electrode of a material soluble in the electrolyte, the other being inert with respect thereto. However accomplished, the effect is to permit the accumulation upon one electrode only of an insulating sheath of gaseous products of the electrolysis when the current passes in a given direction, whereas a reversal is followed by gas evolution at both terminals, the result being an asymmetric effect due to the gas envelopes, upon which are superposed such effects as may arise from the e. m. f. of the cell functioning as a battery, and from the counter e. m. f. from the liberated products of the electrolysis. It is clear that the "asymmetric efficiency" of such a system must depend upon many factors, chief among which is the ratio of the electrode surfaces, as governing both the thickness of the gas sheath and the period required for the counter e. m. f. to reach its full value. No data are given from which an estimate may be formed as to the value or limitations of the cell as a current rectifier.

LETTERS TO THE EDITORS.

Single Phase Electric Traction.

To the Editors of Electrical World and Engineer:

Sirs.—You will realize that the important question of the day, as per the editorials in your valuable paper, is deeply interesting to me. I have done everything I could to point out the advantages of electric traction with alternating-current motors.

I am interested in just the matters that your editorials deal with, and several that they do not deal with. As you know, I have been experimenting for some years on electrical apparatus, especially for street railway and trunk line service from various standpoints, viz., direct current, alternating current and the explosive engine.

You say there is no reason why the polyphase motors are not practical machines for traction work. I have developed one system that solves the speed control problem for any system, direct current, alternating current of any number of phases, and also for gas or any other power systems.

Your editorial of March 23 says, "The whole question of speed control is one which up to this time engineers have shied at." Now, I want to say that one of them has not "shied" at his problem, for its solution was one of the easiest that I have had to deal with. My patents have been allowed without a citation or rejection, and I should be pleased to show you how extremely easy this matter becomes, and how simple the apparatus is in practice.

I have two full size cars at Philadelphia, equipped throughout, and for control of speed and economy of such control, I will state that practical results demonstrate beyond dispute that there is absolutely no railway equipment that will compare with it.

Now that Ganz & Co. have produced a polyphase system which they are willing to install at a price $1,000,000 cheaper than the representatives from this country can touch, I will say that if a single-phase equipment were installed under my system, it could be done at a price fully $1,000,000 cheaper than the Ganz Company's price.

On dynamos and motors we can cut way under either domestic or foreign prices. I don't at all mind being in the same position as a champion of the single-phase system that other engineers have occupied in endeavoring to promote the multi-phase systems.

That the engineers in this country can, with profit, follow the Ganz Company's development and application of polyphase traction apparatus closely certainly seems true, but I suggest that in order to keep the American development and application at the head of the line that the single-phase motor and single-phase distribution system should be developed and applied.

I have developed such a motor and system of distribution, and can state without fear of contradiction that I will convince any engineer or committee of engineers that under my system a single-phase traction equipment is the superior of any polyphase system that ever was or ever will be developed. If you feel that you would like to put me in position where I can demonstrate what I say to be true, and knowing that you say that while such things "are expensive, but should be tried for the benefit of those who come after us," I ask that you publish this letter.

PHILADELPHIA, PA. GORDON J. SCOTT.

Electro-Chemistry.

To the Editors of Electrical World and Engineer:

Sirs.—Your editorial in the issue of April 27 and the communication by Mr. Edgar F. Smith on instruction in electro-chemistry have been read with considerable interest.

You will probably find that in most of the larger universities of the Middle West at least not only is instruction given in the most recent developments in electro-chemical theory, but the commercial applications are also studied.

The Department of Chemistry of the University of Illinois offers three courses in electro-chemistry, and reference to the synopsis of these given in the annual register will show that they are certainly not based on methods a quarter of a century old.

The Department of Electrical Engineering offers three elective groups for the last year and a half of its four-year undergraduate course in electrical engineering, namely: (1) regular electrical engineering course; (2) the electro-physical course, or (3) the electro-chemical course. On the satisfactory completion of any one of these

four years' courses of study with the presentation of a thesis, the student receives the degree of Bachelor of Science in Electrical Engineering.

In addition to this, all undergraduates following the regular electrical course are required to take a course in electro-metallurgy. This includes a brief study of the theory of electrolysis as developed by Nernst, Van't Hoff and Ostwald, and its application in the study of primary and secondary cells, electro-plating and typing, the electrolytic production and refining of metals, applications of the electric furnace, electrolytic manufacture of chemicals, sewage purification, applications of the transformer in heating and welding, etc.

While there is no recent text-book in English which takes up the technical side of this subject still the material contained in the German, English and French periodicals is certainly not small, and one must always go to the journals for the latest and best practice in any branch of electrical engineering.

WM. HAND BROWNE, JR.

CHAMPAIGN, ILL.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Polyphase Machinery.—EBORALL.—An abstract of the first of a series of lectures on "polyphase working." He examined the features of inductor machines and the reasons for their gradual abandonment by Continental makers. Not only is half of the armature copper wasted in these machines, as compared with the now ordinary type of rotating field magnets with alternate polarity, but the leakage flux, which is great, induces a back e. m. f. in the idle part of the windings. In a revolving field alternator the magnetic leakage can be compensated for by adding more windings. It is mere leakage and does not produce back e. m. f.; then there is more trouble with the inductor type of machine if the revolving part becomes slightly eccentric. The only advantages of the inductor alternator are the absence of slip-rings and the use of less field magnet winding. For use with steam turbines, however, he thinks inductor alternators might yet be retained, as they are pre-eminently suitable for high speeds. After comparing revolving field and revolving armature machines, he discussed the relative advantages of star and mesh winding. He prefers star winding, whatever the output of the machine, on account of the cross currents, which may be obtained in mesh armatures under unfavorable conditions. He recommends one or two slots per pole per phase for high pressure machines, and three or four slots per pole per phase for low-pressure machines. He prefers to laminate merely the pole tips of the field magnet rather than the whole pole pieces, and considers that all well designed alternators should have oval poles with laminated shoes cast into the pole core. The question of magnetic leakage he considers to be the most important factor in polyphase alternator design. He prefers to wind the magnets with copper strip set on edge, and previously compressed hydraulically, and to excite the magnets with separately driven dynamos, as these are better than direct-driven exciters in view of pressure regulation and good parallel running. He recommends the following numbers: Peripheral speed of field magnets 5600 to 6000 ft. per minute. Flux densities in lines per square inch; in cast iron, 40,000; in cast steel, 90,000; in pole cores, 90,000; in pole shoes, 105,000; in air-gap, 60,000; in armature teeth, 720,000; in armature iron, 40,000. Current densities: 800 to 1000 amperes per square inch in field, and 1500 to 2000 in armature.—Lond. *Elec.*, May 3.

Short Circuit of Three-Phase Machines.—ROSENBERG.—A paper, illustrated by diagrams, on a phenomenon occurring in short circuited three-phase machines. In a star connected three-phase generator, on which only the external terminals are short circuited, there is a measurable e. m. f. between the common connection point (neutral point) and the short circuit point. This was found to be 440 volts for a short circuit of 61 amperes in a 1000-volt, 20.2-ampere, 50 periods, eight-pole three-phase generator. He shows that this is due to the fact that the wave form is not a pure sine wave. He gives a complete mathematical theory of the phenomenon with the aid of diagrams in which he uses solid geometry. He recommends the use of solid geometry diagrams for the investigation of cases in which the action of alternating currents of different frequency or of alternating currents and direct currents, is combined. —*Elek. Zeit.*, April 25, May 2.

REFERENCES.

General Transformer Diagrams.—KUHLMANN.—An illustrated article on dynamos for special cases of the general transformer. He develops the Ossanna diagram for ordinary three-phase induction motors and deals also with the case of a transformer operating with constant secondary-phase difference.—*Elek. Zeit.*, April 18.

Three-Phase Motors.—GOLDSCHMIDT.—A theoretical article on three-phase induction motors. He begins with general remarks about pure sine fields and deformed fields, and the effects due to the deformation of fields, and applies his results to the short-circuiting and the starting of three-phase induction motors.—*Elek. Zeit.*, April 18.

Synchronous Converters.—COLLES.—A continuation of his long illustrated article on "Rotary transformers, their history, theory and characteristics." He continues the discussion of the theory of the single coil rotary transformers, and deals with the terminal pressure as affected by phase relations, pressure adjustment, pressure regulation for variations of load, current relations, output, efficiency, hunting. He then gives briefly the theory of the two-coil transformers.—*Jour. Frank. Inst.*, May.

LIGHTS AND LIGHTING.

REFERENCE.

Miners' Lamps.—WALKER.—The first part of a paper read before the Brit. Inst. Elec. Eng. on electrical miners' safety lamps. In the present part he discusses in detail the difficulties common to both primary and secondary battery lamps, those peculiar to the secondary battery form of lamp, and those peculiar to the primary battery form of lamps, and gives a review of the different types of secondary battery lamps.—Lond. *Elec.*, May 3.

POWER

REFERENCE.

Gas Power Plant.—An illustrated article on a gas power plant with electric distribution, using for fuel wood or local bituminous coal, in successful operation in a mine in Mexico. Electric motors are used to drive the several departments of the reduction plant.—*Eng. and Min. Jour.*, May 11.

TRACTION.

Electric Automobiles.—SIMONS.—A long paper read before the Electrotechnical Society of Cologne. He first deals with the mechanical construction of an electric automobile. The load ought to be distributed upon both axles, but more upon the driving axle than the other one. One should, however, take care not to place nearly the whole weight upon the driving axle. "A brake which really meets all requirements and which is not too expensive at the same time, is still to be invented." The development of storage battery manufacturing has taken place in two directions. Some manufacturers aim at high capacity with low weight, which means in general a low charge and discharge rate, other manufacturers aim at a high discharge current with a possibility of frequent charges and discharges. For the latter purpose the Plante plate has been further developed, while for the former purpose Faure plates are used. He gives a table of the weight, price, capacity and maximum discharge current per k. g. of weight of cell of several commercial batteries of German make. The highest capacity in ampere-hours per k. g. of weight of cell for a discharge of five hours is 11.55; the maximum discharge current of the same battery per kgr. of weight of cell is 3.46 amperes (Fulmen cell). The cell which has the

greatest maximum current per k. g. of weight of cell, namely, 4.8 amperes, is that of the Acc. Works, Oberspree. He then discusses the motors. In Cologne compound motors are in use. Their advantages over series-wound motors are high-starting torque, variable speed, and the possibility of braking, when at high speed the motor is made to run as shunt motor or as a compound motor. The disadvantages of the compound motor are that its construction is more complicated, and that the controller must be designed with great care and must be very reliable. There have been so far no difficulties in Cologne with compound motors. Passenger automobiles consume on fair roads 57 to 150 watt-hours per ton kilometer, according to speed and construction. The best freight automobiles consume at low speed 60 watt-hours. The automobile company of Cologne estimates for good weather a consumption of about 80 watt-hours per ton-kilometer. He also discusses at some length the commercial question of automobile companies.—*Elek. Zeit.*, April 18.

Electric Resistance of Gas and Water Pipes.—MEAGIN.—A communication on measurements made in Dresden of the electric resistance of joints of gas and water pipes. This is of interest for the question of electrolysis by the return currents of tramways. The resistance of the several joints which originally had been made in an exactly identical manner, was found to be very different. The resistance of 14 joints of a gas pipe which had been buried for 35 years, varied between 0.1 ohm and 1200 ohms. The resistance of 18 joints of a waterpipe which had been buried for 20 years varied between 0.02 and 115 ohms.—*Elek. Zeit.*, April 18.

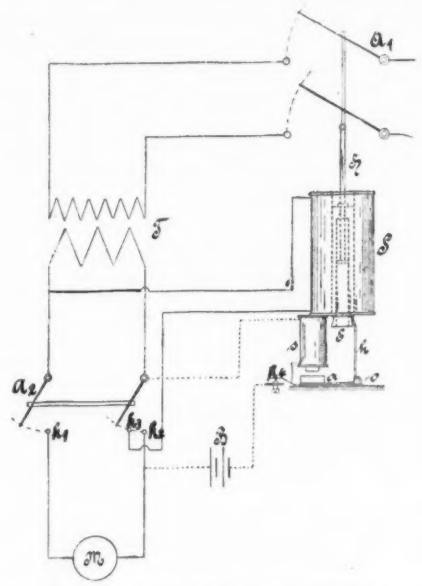
REFERENCES.

Electric Locomotives.—An illustrated description of new electric locomotives, built by a British firm for the City & South London R'y. —Lond. *Elec. Rev.*, May 3.

Automobile.—A long illustrated description of the New York Electric Vehicle Transportation Company's new station.—*Elec. Rev.*, May 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Preventing the No-Load Loss in Transformers.—SCHOLTES.—An illustrated description of a device by which the primaries of a transformer are automatically disconnected from the mains when the secondary circuit is broken, so that losses at no-load are prevented. The arrangement is shown in the adjoining diagram. The instrument consists of a magnet coil *S* with a movable iron core *H* and a small electromagnet *s*. The coils of both magnets are not supplied constantly with current, but only at the moments of opening or closing the circuit, namely *S* from the secondaries of the transformer and *s* from a small separate source of current *B*, like a dry cell. A lever with two arms can rotate around *o*. The one arm is horizontal and bears at its end the magnet armature *a* and the contact k_4; the other *h* is vertical and serves for arresting the movable iron core *H*. The upper end of this iron core forms the switch for the primary circuit *A*. In the illustration the instrument is shown for disconnected motor and transformer. When the motor *M* is to be connected to the circuit, the switch A_2 is closed. Current then flows from the cell *B* to the small electromagnet *s*, which is excited and attracts the armature *a* mounted in the one arm of the lever; the other arm *h* is thereby also moved, so that the iron core *H* is released, falls down by its weight and closes the switch A_1 of the primary circuit of the transformer. The circuit containing the cell *B* remains open, as the lever arm *h* remains out of the perpendicular position by the depth of the groove *E* and therefore the horizontal lever arm is also slightly out of the horizontal position, so that the contact k_4 is open. When the motor is to be disconnected, the switch A_2 is brought into the position shown in the figure. During this motion the switch arm touches the contact k_3 for a moment, and in that moment the magnet coil *s* is strongly excited for an instant by the secondary current of the transformer, the iron core *H* is attracted upward until it is arrested by the lever arm *h* catching the groove *E*, and the primary circuit is broken. The advantages of the instrument are that it has only two movable parts; that the primary circuit is opened after the secondary has been opened, so that only the small no-load current is broken, and that the magnet coils are not supplied with current continually. The apparatus has been in successful use for a year in Nuernberg.—*Elek. Zeit.*, April 25.



NO-LOAD LOSS IN TRANSFORMERS.

Electric Installation in a Packing House.—An illustrated article on the electric installation of the Cudahy Packing Company at Kansas City, Mo. Direct current at 230 volts is used for both power and lighting. There are about 40 motors scattered throughout the plant, ranging from ¼ horse-power to 75 horse-power, and aggregating about 700 horse-power. There are about 3000 incandescent lamps and 15 enclosed arc lamps. The power plant contains two units of 350 kilowatts and 200 kilowatts, respectively.—*West Elec.*, May 4.

REFERENCES.

Manchester.—An illustrated description of two direct-current generating sets among the recent additions to the Manchester electric plant. Each is rated at 750 kilowatts, and consists of a Westinghouse multipolar generator direct coupled to a Ferranti steam engine.—Lond. *Elec.*, April 26.

Wigan.—An illustrated description of this new British lighting and traction plant. The direct-current three-wire system is used for lighting, with 230 volts on the consumers' terminals. The dynamos may be used for either lighting or traction, generating in the latter case at 500 to 550 volts.—Lond. *Elec. Rev.*, April 26.

Denver.—An illustrated article on the Lacombe central station in Denver. It has two departments, one providing energy for 1250 arc lights of 2000 candle-power, the other for commercial lighting; the latter contains two 375-kw two-phase generators.—*West. Elec.*, May 11.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Soldering of Aluminum.—An article of a general nature on the soldering of aluminum wires. It seems to contain nothing new.—Lond. *Elec. Rev.*, April 26.

ELECTRO-PHYSICS AND MAGNETISM.

Sine Currents.—WIEN.—A description of an apparatus for producing sinusoidal alternating currents with frequencies as high as 8500 periods per second. A disk of wood or brass carries a number of pieces of transformer sheet-iron around its rim, and the latter moves between the poles of an electromagnet. The alternations thus generated are reinforcd by what the author terms "electric resonance," which consists in bringing the proper period of the electric system into unison with the frequency, by inserting a suitable capacity, and regulating the inductance. By this device the amplitude of the main current is greatly augmented, while the overtones remain small as before. None of the higher components have an amplitude exceeding 1 per cent of the main amplitude. The latter is 0.2 ampere, with a resistance of 100 ohms. For experiments in which the currents need not be very purely sinusoidal, double the frequency may be produced with the same apparatus, viz., 17,000 periods per second.—*Ann. der Physik.*, No. 3; abstracted in Lond. *Elec.*, April 19.

Coherer—GUTHE.—An account of an experimental investigation of the action of the coherer. He urges experimenting with coherers of a form as simple as possible. He investigated coherers with one contact only. He used spherical surfaces stamped out of metal sheet. The resistance could be adjusted by means of a fine screw. He had formerly found that the p. d. during the passage of the cur-

rent increases with the latter, finally reaching a constant value which is independent of a further increase of the current or changes in the applied e. m. f. He had called this value the critical value of the coherer and had determined it for a few metals. He has not extended this investigation to a large number of metals. The critical voltage varies appreciably when different metals are used. He also studied the "negative action," by which he means the increase of resistance under the influence of electric waves. He shows that it is due to disturbing influences, and cannot be considered a normal phenomenon, as Bose supposes. He also investigated the influence which the heating of the contact has upon the resistance of the coherer. The higher the temperature of the contact the lower appeared to be the resistance of the coherer under otherwise similar conditions, and the resistance returned to its original high value when the heating ceased. He believes that in the action of the coherer the heating of the contact plays an important part. By it the first impulse to the lowering of resistance is given. It may be called the first stage. When the contact is not heated by the current passing through the coherer, the resistance very soon increases on cooling, while after actual cohesion has taken place, a metallic contact is produced and the resistance returns only very slowly to its high value.—*Phys. Rev.*, April.

REFERENCES.

Propagation of Polyphase Currents Along Parallel Wires.—MORTON.—A mathematical paper in which he calculates the speed of propagation and the attenuation in a number of parallel wires arranged in a regular polygon and alternating currents with a constant phase difference between consecutive wires. The assumption is made that the radii of the wires are small compared with their mutual distances. The different cases up to 12 wires are worked out numerically and the results are exhibited graphically.—*Phil. Mag.*, May.

Brush Discharge.—PRZIBAM.—An illustrated account of experiments made to investigate the nature of the brush discharge by photographic methods. He discharges the electrode directly upon a rotating photographic film.—*Acad. Wiss.*, Vienna; an illustrated abstract in Lond. *Elec. Rev.*, April 26.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Chemical Action.—C. J. REED.—The first part of an illustrated Franklin Inst. paper on "Electro-chemical action." This part deals mainly with the general principles of electro-chemical action and with an exposition of Thomson's rule. A thermo-electric process is called exothermic or endothermic, respectively, if heat is evolved at the expense of chemical energy of the system or if heat is absorbed with the accumulation of chemical energy within the system. He suggests an analogous nomenclature for an electro-chemical process. It is called "electrogenic" or "electrothanic," when chemical energy is changed into electrical energy or electrical energy into chemical energy, respectively. Electro-chemical action always takes place at the bounding surface of a reacting body, and only at the surfaces through which an electric current is either entering or leaving the reacting body, i. e., the electrolyte. An electro-chemical system always comprises two electrodes, each in contact with an electrolyte. The electrolyte is necessarily a compound body separable into two constituents, one of which undergoes chemical change at one terminal and the other at the other terminal. These two reactions, occurring in series at the two terminals, are always of an opposite or different character, and are so related to each other that the reaction at one terminal is impossible without the reaction at the other. A cell with two copper electrodes and copper sulphate as electrolyte, is an "agenic" cell. If, by means of an external source of electric energy, current is sent through this cell, at one electrode copper is dissolved, at the other deposited. The reaction at the first electrode is electrogenic, at the second electrothanic, both reactions are equal and opposite, so that in the whole neither electrical energy is changed into chemical energy, nor chemical energy into electrical energy. In the case of a Daniell cell which generates current, the reaction at the zinc electrode is electrogenic and corresponds, according to Thomson's rule, to the generation of 2.3 volts, the reaction at the copper electrode is electrothanic and corresponds to the absorption of 1.21 volts, hence the whole cell has an e. m. f. of 1.09 volts, so that the calculation of the e. m. f. from the thermo-chemical data is in agreement with the facts. He then gives a long list of substances, the compounds of which have positive formation heats, and a brief list of substances some compounds of which have negative formation heats. He then defines the "electrogenic power of a compound" as the "intensity of the electrical energy evolved by the electro-chemical formation of the compound. It is proportional to and measured by the formation heat of the same compound, formed thermo-chemically. Electrothanic power is merely negative electrogenic power." He then gives a long and useful table of electrogenic powers of chlorides, bromides, oxides and sulphates, giving in three columns the chemical symbols, the formation heats in gram-calories, and the corresponding electro-chemical e. m. f.'s or electrogenic powers. A result of this table, which is of particular interest, is the simple numerical relation between chlorides and bromides, which apparently indicates that the energy of combination is the sum of two or more constants inherent in the several elements. (This appears to lead to Le Blanc's theory of the "Haftintensität" of the several ions.) The table enables one to calculate the e. m. f.'s of a large number of cells, due to electro-chemical action. About 4.5 volts is the upper limit of electro-chemical e. m. f. theoretically obtainable in any single electro-chemical system by any combination of known substances, except perhaps caesium.—*Jour. Frank. Inst.*, May.

Calcium Carbide Industry.—Some notes from an article by Rose, on the present European calcium carbide industry, due to over-speculation and overproduction in recent years. During 1900 the price of carbide has fallen from $20 to $10 per ton at Hamburg, and at the latter price many of the works have ceased to yield profit. There is no hope of a decided recovery in price. At Thusis, in Switzerland, aluminum is to be manufactured in place of carbide, while the power of the carbide works at Ruhr is to be devoted to the manufacture of woodpulp. At Lauterbach, in Switzerland and at Milan, the carbide works have been closed for an indefinite period. It is said that acetylene illumination will have a future, although its field of utilization can never be a very extensive one.—Lond. *Elec.*, April 19.

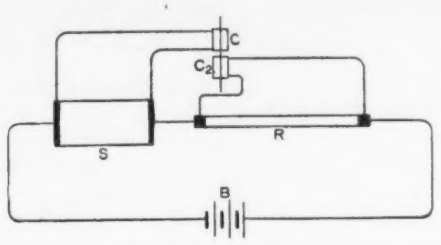
Smelting Iron Electrically.—An article on the question whether the smelting of iron by electricity is practicable. This question is of the greatest importance for countries which are rich in iron ore, but not in fuel. It is pointed out that a certain quantity of energy is required per pound of iron oxide, to separate the oxygen from the iron. It is calculated that with an ideal electrical process of smelting iron, in a year of continuous day and night working, one horse-power could produce 2¾ tons of iron. The coke required to make 2¾ tons of iron in the blast furnace is worth at present about $5.50 while a 24-hour horse-power of electric energy for a year is worth anywhere from $20 upwards. The conclusion is, therefore, that a process of electric iron smelting under the most favorable circumstances would be several times as great as the cost of the present method of reduction of iron by the combustion of fuel in the blast furnace.—*Eng. News*, May 2.

Copper-Cadmium Storage Battery.—GAHL.—A communication referring to the recently published English patent of Edison and giving in some diagrams the results of some tests of a copper-cadmium battery. The discharge e. m. f. was always 0.4 volt, and the watt efficiency was very low. He thinks that, therefore, such a battery cannot compete with the present lead storage battery.—*Elek. Zeit.*, April 18.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Low Resistances in the Workshop.—EDGECUMBE.—An illustrated communication in which he described a direct reading differential instrument for the rapid comparison of low resistance on a commercial scale, the connection being shown in the adjoining diagram. B is a source of direct current, not necessarily constant, S is the standard with which the unknown resistance R is to be compared. From the terminals of S and R wires are run to two coils C rigidly fixed to the same axis, which is so pivoted as to allow the coils to rotate in a strong permanent magnetic field, as in the ordinary moving coil instrument. The two coils are connected in such a way that they tend to turn in opposite directions, and the pole pieces of the magnet are so cut away that, as it moves around, one coil gets into a stronger and stronger field, while the other gets into a weaker and weaker field. The result is, that for any given ratio between the voltage drop in R and S, the moving system takes up a definite position, which is quite independent of the current flowing, and which is indicated by a pointer carried by the coils and moving over a graduated scale. A number of standards S are provided, any one

of which can be inserted in the circuit by means of a plug. Besides being perfectly dead-beat and direct-reading, the instrument has the advantage of enabling a resistance to be measured at its normal working current, and without removal from the circuit in which it may be connected. Thus, for example, the resistance of the coils between neighboring commutator bars can be readily compared without disconnection from the lugs, and a fault immediately localized.



MEASURING LOW RESISTANCES.

While not capable of the same accuracy as the potentiometer method it has the great advantage that any available source of current may be used; whereas by the former method an absolutely constant current is necessary. The two coils being in the same case, temperature errors are eliminated.—Lond. *Elec.*, May 3.

Ammeter and Voltmeter with Adjustable Field.—MENGES.—The instrument is of the D'Arsonval type, and the permanent magnet is provided with an iron piece, acting as a magnetic shunt, the position of which can be adjusted by a screw. The iron core between the poles of the magnet is capable of slight eccentric motion about a horizontal axis, so that the attractions of gravity and of the magnet tend to move it in opposite directions. The magnetic shunt is adjusted until these two attractions are in equilibrium—a condition which corresponds to a definite strength of the field in the air-gap. With a variation of 30 per cent in the strength of the magnet, the strength of the field can in this way be adjusted to within 1 per cent. —*Soc. Franc. Phys. Bull.*, 155, p. 2; abstracted in *Science Abstracts*, April.

REFERENCES.

Differential Galvanometer.—CRAWLEY.—A brief illustrated paper, read before the Brit. Inst. of Elec. Eng., on the use of the differential galvanometer for special purposes, especially for adjusting low resistances. He looks on the differential galvanometer as a potentiometer, only instead of balancing opposing e. m. f.'s one balances the m. m. f.'s. The differential galvanometer is especially suitable for adjusting a set of wires having resistances of a constant ratio, for instance, 1, ½, ¼, etc., ohm.—Lond. *Elec. Rev.*, April 26.

Ballistic Galvanometer.—ROBERTSON.—The conclusion of his mathematical article on the apparent resistance of a ballistic galvanometer of the moving coil type, and a method of allowing for the damping current.—Lond. *Elec.*, April 26.

The Construction of an Electrodynamometer.—KINTNER.—A didactic article on the construction and calibration of an electrodynamometer for students and amateurs.—*Am. Elec.*, May.

Brake Dynamometer.—HUBERT.—An illustrated description of an adjustable brake dynamometer which has several mechanical advantages.—*Elek. Zeit.*, April 18.

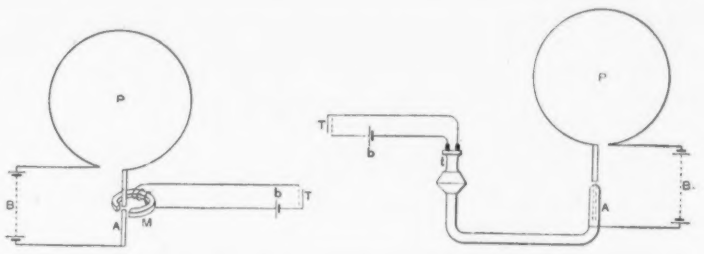
Measuring Hysteresis.—CROOK.—An illustrated description of a yoke with intercepted magnetic circuit, for measuring hysteresis.—*Am. Jour. of Sc.*, May.

Meter Testing.—SMITH.—An article in which he gives some practical rules for testing electric meters.—Lond. *Elec. Rev.*, May 3.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Photographone.—RUHMER.—A description of an interesting method of reproducing sounds from photographic records. Photographic records are the most sensitive and accurate records of sound vibrations, and good photographic records have been obtained both from the ordinary phonograph cylinder and from sensitive flames. His method of reproducting the sounds from the photographic records is as follows: He photographs a "speaking arc" or other sensitive flame on a moving film, and reproduces the sound by projecting light through the film onto a selenium cell in circuit with a battery and telephone. Every variation of the light impinging upon the selenium cell produces a sound in the telephone, and the reproduction is superior in sensitiveness and clearness to the Poulsen telegraphone. Moreover, the film can be made of very considerable length without losing its lightness and portability, which cannot be said of either the wax cylinder or the telegraphone wire. Another great advantage is that any number of equally good prints can be taken off the same negative. Cylindrical lenses are used for concentrating the light upon the film.—*Der Mechaniker*, No. 7; abstracted in Lond. *Elec.*, May 3.

Wireless Telephony.—WILSON and EVANS.—An illustrated description of two fundamental experiments with a direct-current arc. In Fig. 1 *M* is an electromagnet with laminated core energized by currents from a small battery *b* in circuit with a telephone transmitter *T;* the magnet and the transmitter were placed in two different rooms, and were connected by a twin wire. The current in the arc *A* was supplied by a battery *B* and passed through a coil 4 ft. in diameter, consisting of 40 turns. "A similar coil placed opposite *P* served as a secondary and included a telephone receiver in its circuit." With a silent arc the voice at *T* could be heard in the telephone in this second experiment Fig. 2, a loud-speaking receiver *t* was connected by an india-rubber tube to the lower end of a carbon *A*, from which the core had been extracted.



FIGS. 1 AND 2.—WIRELESS TELEPHONY.

T and *A* are in different rooms. The voice could be heard in the telephone in the secondary circuit placed opposite the primary *P*. "With both these arrangements the best conditions appeared to be that the arc should play all round the periphery of *A*, so that it sustained the full effect of the vibrations."—Lond. *Elec.*, May 3.

Exciters for Wireless Telegraphy.—BRAUN.—A description of two devices for compensating the damping of the oscillations by their own electromagnetic radiation, in order to get nearly pure sine oscillations, favorable radiation conditions, and only a very slight damping. One of the devices consists in attaching the open exciter to a closed condenser circuit. Not only does the capacity of the latter reduce the damping by the spark, but it restores the energy radiated to the exciter. In the second device the exciter is quite detached and represents an interrupted wire. Its lower end is wound into a coil, and in this coil the oscillations of the primary condenser circuit are reproduced by induction. The exciter is then quite sparkless, but, all the same, amplitudes of potential variation may be produced in it of such magnitude as would be valueless if the exciter, with its small capacity, contained a spark-gap. Resonance between the primary and secondary circuits is very essential.—*Phys. Zeit.*, March 23; abstracted in Lond. *Elec.*, May 3.

REFERENCES.

Simultaneous Telephony and Telegraphy.—JENTSCH.—An illustrated description of the system of simultaneous telephony and Hughes telegraphy on telephone wires, which is in successful use on several long-distance lines in Germany and between Germany and Austria.—*Elek. Zeit.*, April 18.

Telephone and Trolley Wires.—An illustrated description of two new devices, brought out by an English firm, for directly earthing a broken trolley wire or a broken telephone wire which is in contact with a trolley wire, and thus ensuring the passage of sufficient current either to blow the fuse in the junction box, or to release the circuit breaker at the station.—Lond. *Elec. Rev.*, April 26.

Early Telephony.—LOCKWOOD.—An illustrated article giving some reminiscences of early telephone days in Boston.—*Tel. Mag.*, May.

Sandusky.—DOBBS.—An illustrated article on the new equipment of the Sandusky Telephone Co.—*Elec. Rev.*, May 4.

Statistical.—The conclusion of the statistical article on telegraphy and telephony in Hungary in 1898 and 1899; comparative statistical tables on telegraphy in 1899 in different countries of the world.—*Jour. Teleg.*, April 25.

Telegraphone.—An illustrated description of Poulsen's instrument, repeatedly referred to in the Digest. The wire type and the ribbon

type are on view at the offices of the Telegraphone Syndicate in London. The idea of using the instrument as a telephonic relay has not yet been put into practice in such a way as to obtain definite results.—Lond. *Elec.*, April 26.

Submarine Signaling.—An illustrated article on the experiments made by Mundy and Elisha Gray in submarine signaling.—*Tel. Mag.*, May.

MISCELLANEOUS.

The Thermite Welding Process.—A note on "An interesting demonstration" of the Goldschmidt method of welding, recently made in England. The process was repeatedly referred to in the Digest. In that demonstration several pipes were welded with great ease, as also were two lengths of steel tramway rails. The ends to be welded are filed, the separate pieces are clamped firmly together, and the joint is then surrounded by a sheet-iron casing, jacketed externally with moist sand, which again is kept in place by a box surrounding it. The thermite, consisting of aluminum and oxide of iron in about the proportions of one to three, is then prepared in a crucible lined with magnesia or alumina, and a small quantity of superoxide of barium is sprinkled over the mixture, after which the whole is ignited with an ordinary match. The chemical reactions are very vigorous, the whole becoming molten in a very short time, when the mass, which has separated into two layers, may be poured into the mold. The top layer consists of an oxide of aluminum, which immediately forms a thin coat round the pieces, thus effectually preventing the iron which follows being welded to them. When the welding temperature is reached the clamps are slightly tightened, and, after cooling, the whole mass can be easily removed. By a simple modification, the iron from the thermite mixture can also be welded onto the joint. This consists in having a small opening at the bottom of the crucible covered by a piece of sheet iron. The crucible is in this case placed over the mold, and when the reaction takes place the sheet iron is melted, and the iron at the bottom of the crucible touches the joint before the slag, and is welded to it. A 3-inch pipe 0.16 inch thick can be welded with 5 lbs. of thermite. The distance of the sheet iron mold from the pipe is 0.72 inch, and the length of the mold 3.2 inches. The welding temperature is reached 1½ minutes after the thermite is poured in. The makers claim that the cost of welding two 2-inch tubes is from 50 cents to $2, according as the thickness ranged from 0.10 to 0.24 inch, the prices including crucible, mold and labor.—Lond. *Elec.*, May 3.

REFERENCES.

Manufacturing Plant.—The first part of an illustrated article on the works of the Westinghouse Co.—*Elec. Rev.*, May 11.

Manufacturing Plant.—The first parts of an illustrated description of plants in Germany which will be visited in this year's trip of the British Inst. Elec. Eng. These parts deal with the machine factory and the instrument factory of the Gen. Elec. Co., of Berlin.—Lond. *Elec. Eng.*, April 26, May 3.

Paris Exposition.—Picou.—A paper read before the Internat. Soc. of Elec. in Paris on the electric light and power service of the Exposition.—*Bull. de la Soc. Int. des Elec.*, March.

The conclusion of the illustrated serial on electric exhibits. This part deals with the O'Keenan meter, the Lux meter, the Hackl arc lamp of Ganz & Co., the Mougin arc lamp and searchlights exhibited. —Lond. *Elec.*, May 3.

New Book.

Kalender fur Elektrochemiker. Sowie Technische Chemiker und Physiker fur das Jahr 1901, mit einer beilage jahrgang. Von Dr. A. Neuberger. Berlin: M. Krayn. 524 pages, 21 illustrations. Beilage, 432 pages. Price, 5 Marks.

A peculiar German custom is to publish pocket reference books in the form of a diary with dated blank pages, followed by the book itself, hence the name "calendar" which they often bear. In Germany, where nearly every engineer always carries with him his slide rule, reference book, diary and pencil, this has its advantages, while for those who do not care to use the diary part, the 80 pages devoted to it do no harm. But the great advantage of publishing pocket reference books in the form of an annual is that the edition is (or should be) revised each year and brought up to date; and to the publisher it has the advantage that many buy the new edition each year and discard the old.

The present work is this year's edition of a pocket reference book on electrochemistry, and is prepared in the usual pocket book style, with this difference, that only the first part is bound for the pocket, the second half, being in paper and containing such information as is not wanted sufficiently often to carry in the pocket, but can better be kept on the desk. A curious result of this sub-division, however, is that the desk part is the one which contains the rules concerning the immediate assistance and treatment of those who have been severely shocked by electric currents, or poisoned, the very information one needs in the greatest hurry.

For any one working in electrochemistry, this reference book is of great value and no electrochemist should be without it, or one like it if such exists. It contains such information as one expects to find in a small reference book, and is limited largely, though not exclusively, to electrochemistry. Like most books of its kind, it is a compilation, and it is all the better for it, as what is wanted is the result of the best work and data existing, and this never the production of one brain. Moreover, the author is the editor of one of the first journals published exclusively on electrochemistry, and therefore he may be expected to be posted on what is being published from month to month on this subject.

The book is also of value in that it is, we believe, the only pocket reference book published on electrochemistry. It may therefore be recommended highly as being very useful. But this must not be construed as an endorsement of everything in it, as we regret to say that it is not at all well edited. The author has in many cases merely copied tables and data, without stating clearly the meanings of the figures, the units in which they are given, and such other information which is so necessary in order to use the tables or constants. In some cases this missing information could be supplied by an experienced engineer who may either know it or could determine it by comparisons with known data, but this is troublesome and annoying. In other cases, however, the data becomes absolutely useless for the want of some essential information. Of what use, for instance, are the internal resistances of batteries without their dimensions? In many cases the numbers in tables are not reduced to modern units, thus involving a further time-robbing reduction by those who use the data during the year 1901 for which this book is intended. For instance, the pages of specific resistances of liquids are given in terms of the now ancient Siemens unit. Others are given for a foot-cube. Conductivities are given without any reference to any unit, although there are as many units of conductivity as there are of resistance. A careful author would have been very particular about supplying all necessary explanation of the data and would have reduced all the constants to modern terms.

Nor can claims be made for reasonable completeness, notwithstanding the fact that very large quantities of data are given; there are omissions which in a fifth edition should have been supplied, especially as claims are made in the preface that this edition has been thoroughly revised and brought up to date. Moreover, there is no index, but merely a table of contents in the order of the pages, which involves much labor in looking for any particular subject, especially as the classification is not the one many others would have chosen. Matters are made much worse by the fact that even in this table of contents there are inexcusable errors. For instance, for the subject of the heat of formation the table of contents gives page 416 in the second volume, which however contains nothing at all on this subject, nor does that page in the first volume; a page by page search shows it to be on page 452 of the first volume. The index for the second volume is only in the first.

The reviewer has not examined the data for correctness, but from some isolated cases it seems as though no great care was taken to obtain the most recent and best data. Cases might be multiplied to show that the author has been careless, which is very unfortunate. Nevertheless, there is much in the book that is of value, and it is to be hoped that more care will be taken with subsequent editions.

The book also devotes much space to the general laws of electricity, which have no connection with electro-chemistry; also to chemistry, physics, mathematics, mechanics, machines, fuels, laws, and miscellaneous information, chiefly of use in Germany. Whether all this should be included in a book on electro-chemistry is a matter of opinion. The reviewer believes that much of it is out of place and should be left to reference books on those particular subjects, as there exists too much useful reference matter in each branch to try and include it all in one small book.

Directory of Electrical Societies, Etc.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES. Next meeting, Buffalo, N. Y., June 11, 12 and 13, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., September, 1901.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Rochester, N. Y., September, 1901.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Sheboygan, Wis., last week in June, 1901.

OHIO ELECTRIC LIGHT ASSOCIATION. Next meeting, Put-in-Bay, Ohio, Aug. 20, 21 and 22.

OLD TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, York, Pa., Sept. 4, 1901.

6000 H. P. Westinghouse Engine for the New York Gas, Electric Light, Heat and Power Company.

The latest Westinghouse engine and the largest yet built, is a 6000-hp Westinghouse-Corliss engine. It is the first one of eight similar ones intended for the waterside power station of the New York Gas & Electric Light, Heat & Power Company.

The engine is of the familiar inverted cross-compound type. The base consists of three rectangular pieces weighing in the aggregate 100 tons. Upon this base are set the three housings with circular flange tops. Each housing, consisting of two parts which bolt together, is very stiffly ribbed. Bolted on the housings are the crosshead guide frames of which there is one for each housing. Each guide frame is surmounted by its cylinder, there being one high pressure, and two low pressure, the middle one being a high-pressure cylinder and the outer ones being low pressure. There are three platforms circumscribing the engine, the first platform at the height of the housing and the second at the height of the guide frame, the third platform surmounts the tops of the cylinders.

The high-pressure cylinder is 43½ inches in diameter, and the two low-pressure cylinders each 75½ inches in diameter. The stroke is 60 inches and the speed 75 r. p. m. The high-pressure cylinder is not jacketed, and from this cylinder the steam passes into a receiver 4 ft. 6 inches in diameter and 23 ft. in length over all. The volume of this receiver is 210 cubic feet, and it contains 110 tubes, giving about 1200 square feet of heating surface. This heater is placed horizontally across the rear of the guide frame portion. The low-pressure cylinders are steam jacketed.

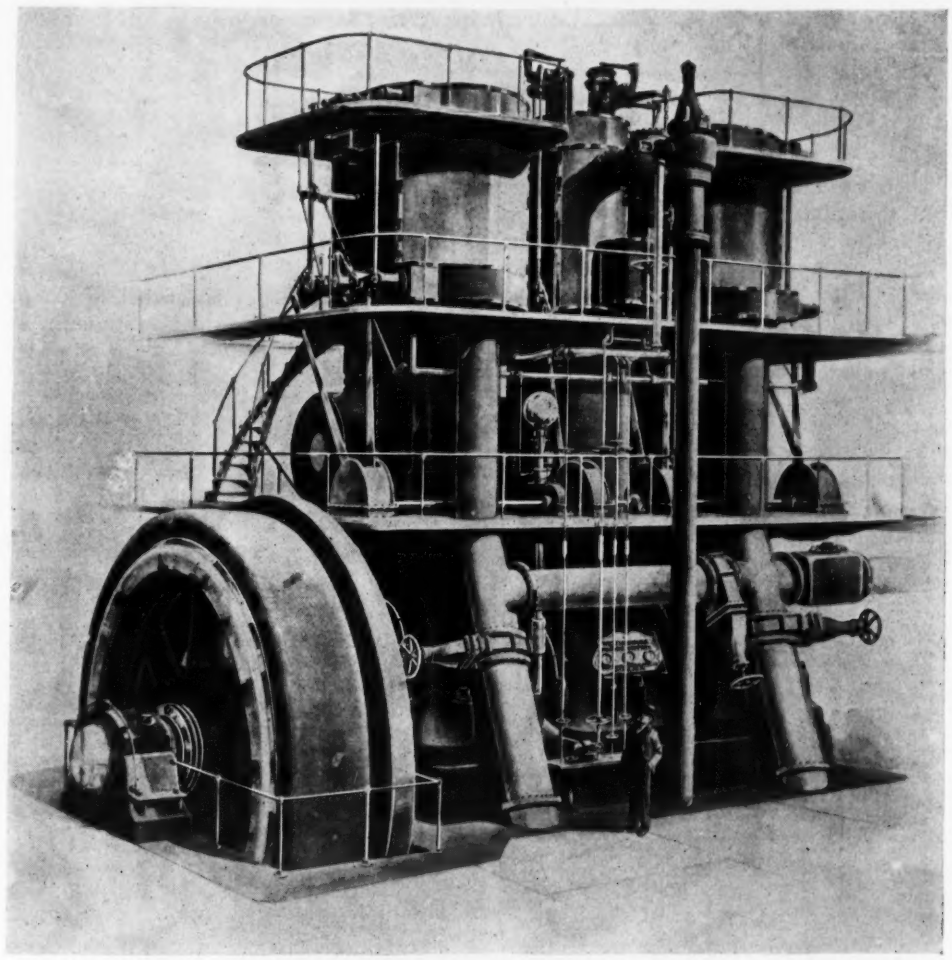
The valves are all double ported, and as close together as will allow of proper valve gear construction. The high-pressure cylinder has balanced poppet valves actuated by a releasing gear, and the low-pressure cylinders Corliss valves operated by the usual wrist plate and tie rods. This unusual combination of valves was substituted for all Corliss valves because of the high temperature at which steam enters the high-pressure cylinder. This steam, which is under a pressure of 175 lbs., is superheated 200 degs., making its total temperature 577 degs. At this temperature it is practically impossible to provide the efficient lubrication necessary to the proper working of Corliss valves.

Each connecting rod is a steel forging, and is 13 ft. 9 inches long between centres. The top end of each connecting rod is of the ordinary solid type with wedge adjustment, and the bottom end is of the so-called marine type. The crosshead pins are 14 by 14 inches, and the crank pins, 14 inches in length, are 22 inches in diameter. The cranks are of cast steel, and are of the usual type, not as is customary, set 120 degs. apart, but at unequal angles, selected to give the best possible turning movement, which, owing to the service of the engines, is a matter of capital importance.

The main shaft is of open hearth, fluid compressed, hydraulically forged steel, as are the connecting rods, and was supplied by the Bethlehem Steel Company. This shaft is hollow, and of 10 inches internal diameter at the wheel fit and 9 inches at the bearings. The total weight of the main shaft is 136,000 lbs.

An interesting departure from ordinary engineering practice is to be found in the way motion is given to the eccentrics that control the valve movements. Usually the eccentrics are mounted directly on the main shaft. In this instance the eccentrics are mounted on a lay shaft located at the level of the first platform. This auxiliary shaft is driven by a spiral gear. The advantages to be derived from moving the eccentrics in this way are manifold. The chief one is, however, the saving of energy by reducing the size of the eccentric straps. The diameter of the main shaft is 29½ inches, while the diameter of the lay shaft is 6 inches. The eccentric straps and the friction caused by their rubbing surfaces are reduced accordingly.

The flywheel is of novel design and comparatively small, because a more uniform turning moment is given by the three unequally spaced cranks than is possible with two cranks. The center is of air-furnace iron, and the arms and rim of cast steel made in five sections, each comprising 72 degs. of rim and two of the ten radial arms. These five sections are joined together by I-links shrunk into pockets, and are bolted into the hub, forming a wheel 23 feet in diameter and of 9 inches face, having a radial depth of 30 inches.



6000-HP WESTINGHOUSE-CORLISS ENGINE.

Upon either side of this wheel are riveted upon its rim and flush

with its face, five circular pieces of 72 degs. angular length each. These pieces are 3¾-inch face and 27½-inch depth, making a total face width of 16½ inches. These side segments are also fastened together by I-links, but the joints are broken with those of the central wheel rim. The peripheral speed is 5416 ft., or about a mile a minute.

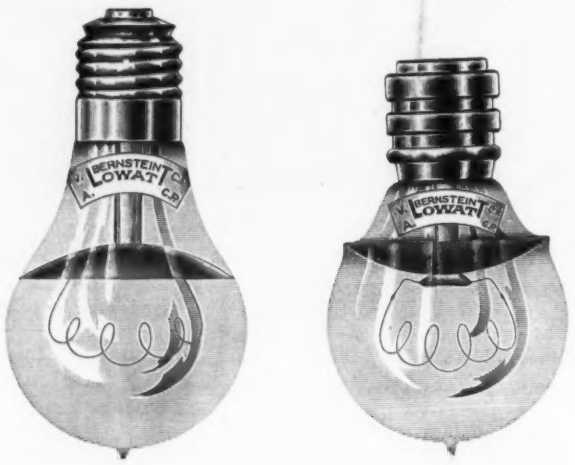
An automatic stop-valve is provided which shuts off the steam supply in case the speed exceeds any fixed limit. In brief, it may be described as a valve which is closed by steam admitted through a three-way cock. In a pocket in the face of one of the high-pressure crank checks is pivoted a short weighted lever, balanced against centrifugal force at normal speed by a helical spring. Should normal speed be exceeded, the weighted lever flies out, and engages with a spring lever pivoted on the engine base. This action turns the three-way cock above mentioned, admitting steam to a chamber of the angle stop valve on the steam supply main, and this valve is promptly closed. There is also provision at a number of points about the engine for hand control of this same stop valve.

The engine is 37¼ ft. from the floor line to the top of the cylinders; 41 ft. across the front and 23 ft. from front to rear. Its entire weight is more than 1,500,000 lbs., and above 15,000 separate pieces go to make it. So strongly built is this engine that it can deliver, in an emergency, 10,000 horse-power, which is almost double its most economical rating. Each engine is to be coupled direct to a 5000-kw generator of the revolving field type. The armature of this generator is to be pressed on the shaft alongside the flywheel, and in addition to being securely keyed to the shaft it is to be rigidly attached to the flywheel hub by means of direct bolting. The outer end of the generator shaft is to be supported by a heavy pedestal carried on an iron sub-base.

Reflector Incandescent Lamps.

There are many situations where the distribution of illumination from the ordinary incandescent lamps is not the most convenient or efficient, and this is particularly true where the illumination is dependent upon a few lamps or a single lamp. In order to meet this condition the Bernstein Electric Manufacturing Company, of Boston, Mass., has perfected and placed on the market a type of lamp, the direction of radiation from which is controlled by means of a metal reflector contained entirely within the bulb of the lamp. One of the forms of this type, shown in Fig. 1, concentrates and throws the light directly away from the socket. This lamp is especially desirable for show windows, signs and in halls, and elsewhere where the lamp is in a high location. For desk, library and general use the lamp is frosted.

Fig. 2 shows the lamp with a convex reflector, which distributes the light about equally in all directions to an angle somewhat above



FIGS. 1 AND 2.—REFLECTOR LAMPS.

the horizontal. Photometric measurements taken of this lamp shows an almost perfectly spherical distribution of the rays. In still another form of lamp the reflector is at right angles to the socket. This form is especially intended for car headlights, theater footlights and show window side lighting.

Bates Bracket Fan.

The fan illustrated herewith is the direct-current bracket pattern manufactured by Messrs. D. L. Bates & Brother, Dayton, Ohio. The field magnet is of the bipolar, inverted type, provided with end caps screwed to the pole pieces for the protection of the armature and commutator. The magnet core is of forged steel. The machine illustrated is provided with universal adjustment, which permits of the motor and fan being set at any angle.

BRACKET FAN.

The 12-inch fan has a maximum speed of 1900 r. p. m., and consumes 31 watts at 110 volts; the 16-inch size takes 60 watts, its speed being 1600 r. p. m.

These motors are also made in the pedestal pattern for desks, tables, etc.

Wiremen's Pliers.

Two new forms of pliers recently placed on the market by the William Schollhorn Company, New Haven, Conn., are shown in the accompanying cuts. Both tools have such a mechanism that the jaws are parallel at all points of their motion.

Fig. 1 shows a pair of electric cutting pliers, with rubber handle

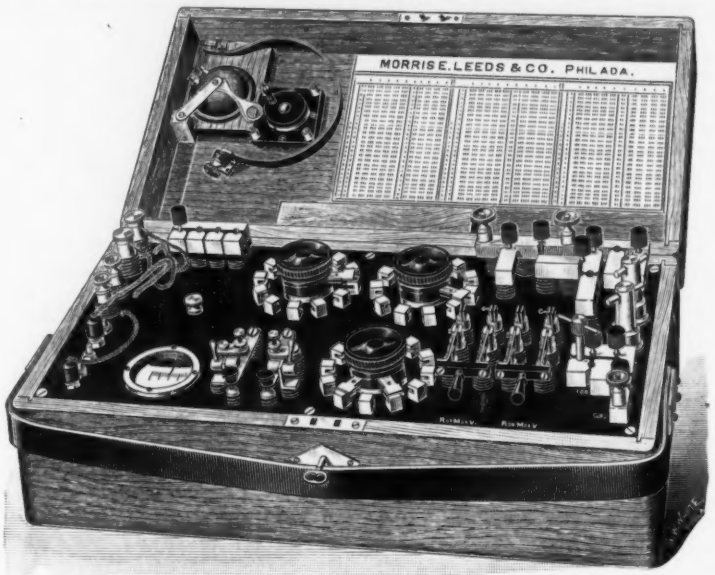
FIGS. 1 AND 2.—PLIERS FOR WIREMEN.

covers. The plain jaws are always parallel to each other. The two cutting jaws are mounted respectively on the two parts of the handle. Fig. 2 shows a tool specially made for cutting and stripping insulated wire. In this case also the jaws are parallel and the tool unites the functions of pliers, cutter and stripper.

A New Cable Testing Outfit.

The portable cable testing set shown in the accompanying illustration was recently designed by Mr. Henry W. Fisher, of the Standard Underground Cable Company, Pittsburg, and represents the latest ideas in apparatus of this class. It is designed for tests where a strictly portable set is required, and therefore is compact and comparatively light in weight. In addition to measurements of capacity insulation and conductivity resistance, it is possible to locate faults by the Murray or Varley loop tests. Mr. Fisher has also introduced a method for locating breaks in cables where the conductor has parted, and a new method for measuring capacity in which a telephone is used in place of a galvanometer. To operate the apparatus rapidly and without complication, a set of double-throw switches change the connections from one test to another without the use of inconvenient flexible cords and without the necessity for remembering a complicated scheme of connections.

For use with this new testing set a portable D'Arsonval galvanometer of high sensibility has been designed, and is so constructed that the apparatus can be used in a laboratory or out of doors, as may be required. Although this cable testing set has not been placed on the market more than a few weeks, it was perfected by Mr. Fisher some time ago, and is entirely beyond the experimental state. Telephone engineers will find this outfit of great value in cable testing. The apparatus is manufactured by Morris E. Leeds & Co., and is handled by James G. Biddle, Philadelphia, who is sole selling agent for the manufacturers.



CABLE TESTING OUTFIT.

Enclosed Arc Lamps.

One of the most important events that has occurred recently in regard to lighting for some time was the report of the municipal committee of the city of Cincinnati, pertaining to the best form of street illuminant. It is encouraging to all manufacturers of electrical apparatus, both of dynamos, as well as arc lamps, as it passed a decided verdict against Welsbachs and in favor of enclosed arcs, as noted in these columns.

The report above referred to, will be very pertinent to manufacturers of enclosed arc lamps, and though there are many such companies in the field, it is possible that others will still be added to the list. One well-known concern making lamps of this type, though in the business but a few years, is the Lea Electric Manufacturing Company, of Elwood, Ind. This company has gained considerable prominence, by bringing out a miniature direct-current lamp for either 110 or 220 volts. The growing demands for this miniature lamp proves that its popularity is increasing.

One of the most important features of this company's enclosed arc lamp is the swinging cover, invented by William H. Northall. By pressing a spring the lamp opens and the cover divides vertically, each half being raised to a horizontal position and supported by automatic catches. When the catches are released, the cover may be closed to with a snap. These covers are supplied to all of the lamps that the company now manufactures. The mechanism of the lamp is very simple, consisting of an iron-clad armature, surrounding a solenoid, the clutch rod and dashpot, the resistance being two grooved porcelain spools, supported from above by a rod and "T." The standard of the lamp is hollow, and the carbon is entirely enclosed in a vacuum. The company has recently brought out standard and miniature alternating lamps for either 60 or 120 cycles. These are also equipped with the swinging cover, which, from its easy accessibility to the interior parts will make the lamps very popular.

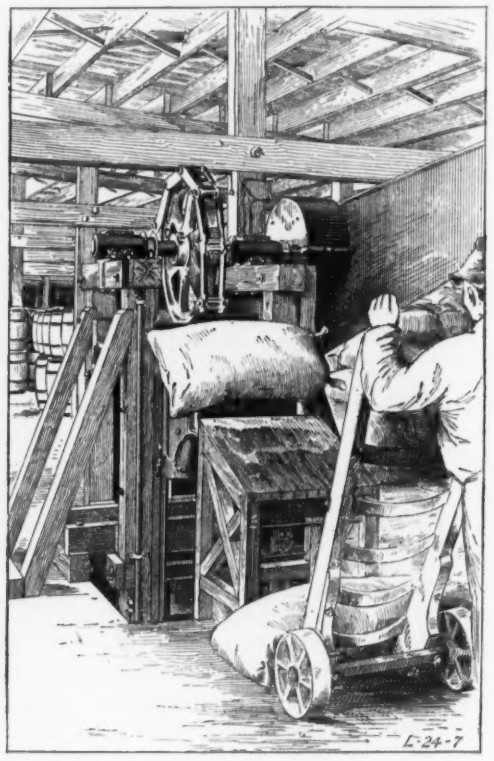
Recent tests have shown that the lamps of this company have very high efficiency, having especially long life without retrimming. The company has a fine exhibit of its product in space "Q," Electrical Building, Pan-American Exposition. Attention is called there to the announcements by this company of its product, such as standard alternating lamps for 60 and 120 cycles on silk pennants, supported on brass standards in the Exposition colors, orange and olive. The company gained considerable prominence at the convention through its male quartette, composed of workmen from its factory, whose singing made them decidedly popular with all the members, and gained them many admirers.

Link-Belt Elevator.

The economic handling and disposition of empty packing cases or other empty receptacles often presents most vexatious problems. To get them out of the way and accessibly stored with all possible expedition is not only desirable, but sometimes imperative.

The empty box elevator illustrated in Fig. 1 was installed for this purpose for the Scott Paper Company, of Philadelphia, by the Link-Belt Engineering Company of the same city. A double strand of "Ewart" link-belting is employed, and at intervals of 5 ft. a straight arm is attached, one to each belt. The machine is mounted in a wooden frame and carries empty boxes from the ground to the upper floor of the warehouse at the rate of 12 per minute.

Another application of this link-belting, adapted for much heavier work, is the link-belt barrel and sack elevator, shown in Fig. 2. This machine is provided with automatic arms, which permit of barrels and sacks being elevated and gently delivered to any floor while simultaneously others are being carried down on the other side. The machine illustrated is in use in the Lehigh Valley Railroad Company's Jersey City freight house. It has 37-ft. centers, and uses heavy malleable iron chain belts, with carrier arms attached every 10 ft. The machine is provided with an adjustable stop so arranged that the barrels are discharged at the proper height to be rolled away on the floor, or the sacks for convenient removal by hand trucks. The head is driven by worm gearing, encased in a housing, and the worm runs in a bath of oil.



FIGS. 1 AND 2.—LINK-BELT ELEVATOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed nominally at 3 per cent. Time money during the week grew more abundant, owing to the recent liquidation in the stock market. The rates are 4½@5 per cent for 30 to 60 days, 4@4½ for three, four, five and six months. Mercantile paper is quoted at 4 per cent for 60 to 90 days indorsed bills receivable, 4@4½ for choice four to six months single names and 5@6 for others. The prices of stocks during the week were firm and generally advanced on the announcement that a compromise had been effected between the interests in contest for control of the Northern Pacific precipitated by the violent break and corner of the week previous. Heavy liquidation of weak speculative accounts marked the early part of the week and renewed declines took place. Transactions were on a decidedly smaller scale, and the public was largely eliminated as a factor in the market. United States Steel stocks, after suffering from heavy liquidating sales, showed strength on reports of early commencement of dividends on both classes of shares. In the traction list Metropolitan Street Railway recovered some of the loss recorded the previous week. It closed at 168, representing a net gain on the week's trading of 5 points, the sales being 73,000 shares. Brooklyn Rapid Transit did not gain any of the losses of the week previous, closing with a net loss of ¼ point. There was some activity in trading, however, the number of shares sold being 153,175. In the electric list, General Electric showed some strength and closed with a net gain of 2 points, the price of this stock ranging between 210¼ and 225, the closing figure being 223. There were 11,200 shares sold. Western Union closed with a net gain of ⅞ points, and American Telegraph & Cable lost the gain of 2 points made the previous week, closing at 98. In outside securities the movement of prices during the week was generally upward, though there were few marked improvements. In the electric list Electric Boat suffered losses in the price of both common and preferred; Electric Vehicle is a little stiffer as to the common issue, and 2 points off on the preferred. The rest of the list stands about the same as at the time of our last report. Following are the closing quotations:

NEW YORK.

	May 11.	May 18.		May 11.	May 18.
General Electric	220	223	Electric Vehicle	10	11
Brooklyn Rapid Transit	77¼	77	Electric Vehicle, pfd.	*24	16
Metropolitan Street Ry	163	168	General Carriage	2¼	2
American Tel. & Cable	100	98	Illinois Elec. Veh. Tran.	⅞	⅞
Western Union Tel.	92½	93⅜	Hudson River Tel.	120	120
American Dist. Tel.	40	—	N. E. Elec. Veh. Tran.	2¾	3¼
Commercial Cable	186	—	N. Y. Elec. Veh. Tran.	2¾	1⅞
Electric Boat	17	14	Tel. & Tel. Co. of Am.	*6½	5
Electric Boat, pfd.	43	40	N. Y. & N. J. Tel.	160	167
Electric Lead Reduc'n	—	2½			

BOSTON.

	May 11.	May 18.		May 11.	May 18.
New England Telephone	—	—	Erie Telephone	—	*60
Mexican Telephone	—	2⅝	General Electric, pfd.	—	—
Westinghouse Electric	—	—	Am. Tel. & Tel.	—	174
Westinghouse Elec., pfd.	—	—	Boston Electric Light	—	*240

PHILADELPHIA.

	May 11.	May 18.		May 11.	May 18.
Electric Storage Battery	—	66	Philadelphia Electric	—	6
Elec. Storage Batt'y, pfd	—	65	Pa. Electric Vehicle	—	1¼
Elec. Co. of America	—	9⅝	Pa. Elec. Veh. pfd.	—	1
General Electric Auto.	—	—	Am. Railways	—	48¾

CHICAGO.

	May 11.	May 18.		May 11.	May 18.
Chicago Edison	170	173	Chicago Telep. Co.	—	260
Chicago City Ry.	—	250	Union Traction	14½	14¾
National Carbon	15¾	15⅜	Union Traction, pfd.	56	57
National Carbon, pfd.	83⅞	82	Northwest Elev. Com.	—	43

*Asked.

PHILADELPHIA COMPANY.—The Philadelphia Company, of Pittsburg, is quite a miscellaneous affair, with its oil territory, gas wells, electrical interests, etc. During the year 67.7 miles of two-wire telephone lines were built. The total amount of telephone lines operated by the company are now 446.7 miles of two-wire system and 27.5 miles of single-wire line. Since Nov. 1, 1899, the company in pursuance of the stockholders' authorization, has acquired by the issue of 126,909⅛ shares of its common stock, 338,425 common shares of the United Traction Company, of Pittsburg, together with the sum of $339,425, being $1 per share required by the terms of the authorization to be paid by the stockholders of the United Traction Company. This fund is being used from time to time in the acquisition of the floating debt of the United Traction Company, and its notes taken for the amount of floating debt are being carried as bills receivable, it being the intention to so carry the debt unless all of the common shares are acquired by this company when the indebtedness should be canceled. The increased business offering to the Allegheny County Light Company rendered imperative large improvements and additions to its plant, and the Philadelphia Company advanced to it $135,000, and for that purpose sold an additional $125,000 of first mortgage bonds, making the total issue of first mortgage bonds to date $4,250,000.

TELEPHONE CONSOLIDATION.—A dispatch from Pittsburg says that it is understood that considerable stock of the Pittsburg & Allegheny Telephone Company has been sold to Baltimore capitalists. The buying is said to be the beginning of a deal by which the Federal Telephone Company will acquire the exchanges, lines, franchises and good will of the Pittsburg & Allegheny concern and its allied interests. The properties the Federal Company is supposed to want are the Pittsburg & Allegheny Telephone Company, the West Penn Long Distance Telephone Company, which is still a paper concern; the Allegheny County Telephone Company, of Braddock; the Homestead Telephone Company and the Home Electric & Telephone Company, of Wilkinsburg. As soon as certain matters are arranged, it is probable the Federal Company will acquire control. The sale will end a bitter warfare. Part of the plan will be the prompt connection of service to many places in the vicinity. The Federal Company has already purchased the independent telephone companies in Elizabeth, Carnegie, Latrobe, McKeesport, Washington, Apollo, Beaver Falls, Avonmore, Cecil, Canonsburg, Leechburg, McDonald, Venice, Youngstown (Pa.), Coraopolis and Sewickley. In addition it is building extensively, its greatest activity just now being in Washington County.

AMERICAN TELEGRAPH & TELEPHONE.—President Alex. Cochrane, of the American Telegraph & Telephone Company, has called a special meeting of stockholders of the American Telegraph & Telephone Company to be held at the New York office of the company, 15 Dey Street, on Monday, June 3, for the purpose of voting upon a proposition to increase its capital stock from $100,000,000 to $150,000,000. At the present time there is $94,237,500 stock of the American Telephone & Telegraph Company outstanding, but only $62,127,100 is in the hands of the public, the balance being in the treasury of the company, having been acquired from the American Bell Telephone Company.

AMERICAN RAILWAYS-ELECTRIC COMPANY OF AMERICA.—According to a Philadelphia dispatch the terms and all arrangements for the American Railways-Electric Company of America consolidation have been practically completed. The new company will issue about $12,000,000 4 per cent bonds to take over A. R. C. stock at 55 and E. C. A. at 11½, giving holders also 35 per cent in new common stock, of which there will be about $5,000,000, and there will also be an issue of preferred stock. Two million five hundred thousand dollars in bonds, with substantial bonus in stock, which has been underwritten, will be sold for cash, and offered to the stockholders.

EARNINGS.—The Buffalo Railway Company reports gross earnings for the quarter ended March 31, $426,487, an increase of $61,264 over the same period last year. The increase in net earnings was $50,390. The gross earnings of the Brooklyn Heights Railroad Company during the same period were $2,650,235, an increase of $54,040 over the same quarter last year. The net earnings decreased $42,901.

CONSOLIDATION IN CHICAGO.—The announcement is made that the Northwestern Elevated Railroad, the Lake Street Elevated Railroad, the Union Loop Company and the Metropolitan Elevated Railroad in Chicago are to be consolidated. In about a fortnight the leading interests in those properties will meet in Chicago and arrange the final details of the merger.

CONSOLIDATION.—Stockholders of the New York Gas, Electric Light, Heat & Power Company and the stockholders of the Edison Electric Illuminating Company have voted favorably on the proposition to consolidate with each other, the vote being practically unanimous.

DIVIDENDS.—The General Electric Company has declared a quarterly dividend of 2 per cent on its common stock, payable July 15. The West Chicago Street Railway Company has declared the regular quarterly dividend of 1½ per cent, payable May 15.

MORTGAGE.—The Bay Counties Power Company has filed a mortgage for $750,000 in favor of the Union Trust Company, of San Francisco, on holdings of machinery, lines, rights of way and real estate.

ERIE TELEPHONE.—A Boston dispatch states that the next regular meeting of the directors of the Erie Telephone Company will be held in Boston on Tuesday, June 25. At this meeting the reports of Stone & Webster, physical experts, and the Eastern Audit Company, accountants, will be officially presented to the board. These reports with a statement of the earnings for the five months ending May 31 of this year may be taken as a basis upon which a plan for permanently financing the company can be founded. Many of the stockholders anticipate the paying of semi-annual dividends at the rate of 4 per cent per annum, the first dividend of 2 per cent to be paid in July. The gross earnings for the three months ending March 31 will exceed the same period last year by $300,000, and a larger percentage of increase can be maintained throughout the year. The permanent plan of financing the company will probably provide for the raising of $15,000,000 of money to be called in as required for extensions and to pay the temporary loan of $7,500,000 at maturity Jan. 10, 1902, thereby dissolving the trust.

MORTGAGE.—A mortgage of $2,000,000 on the property of the Seattle & Tacoma Interurban Railway Company, Seattle, Wash., has been filed there. The mortgage bears interest at 5 per cent, payable semi-annually. The entire property of the company is pledged to the Old Colony Trust Company, of Boston, and the money is to be immediately available. It will be used for construction purposes. The instrument is liable to foreclosure in any one of three events: Nonpayment of interest after 60 days' notice has been given, failure to keep the property free from liens resulting from taxation, assessment, water rates and public charges and failure to maintain a proper insurance on property. By another provision a sinking fund is to be created for the final liquidation of the mortgage.

Commercial Intelligence.

THE WEEK IN TRADE.—The general situation in trade and industry throughout the country is in a satisfactory condition. There are no changes to record, however, notwithstanding the perceptible increase of the spirit of unrest in labor circles. From the heavy grain-producing sections of the country the general situation and outlook is regarded as very satisfactory. The industries are active. Those in the iron and steel trade are working at high speed to overtake orders already received. Foreign trade continues largely to favor this country. Despite the talk of rate-cutting and of expectations of a smaller movement of goods as spring advances, railway earnings continue exceptionally favorable, some great systems reporting maximum weekly earnings. Net returns also are of a good volume and show that business is being done at a decided profit. The building trades are active all over the country, but there has been some disappointment expressed by Eastern lumber dealers at the volume of business done. The failures for the week, as reported by *Bradstreet's,* aggregated 192, as against 193 the week previous, and 155 the same week last year. In the metal market there has been no change in the copper situation. Producers maintain the same prices, but the market is very dull. Lake is quoted at 17 cents and electrolytic at 16⅝ cents. The exports for the first half of this month amounted to 3962 tons, as against 5696 tons for the corresponding period of last year. The imports for the first half of the month amounted to 1327 tons.

ENGINE AND BOILER CONTRACTS.—The New York Safety Steam Power Company, of New York City, reports receipt of the following engine orders during the last few days: 14 by 12 horizontal automatic engine direct connected to a 60-kw C & C generator for Mitchell, Fletcher & Co., Philadelphia; 8 by 9 vertical automatic engine direct connected to 15-kw Triumph generator for the Triumph Electric Company, Chicago; 9 by 12 horizontal automatic engine direct connected to a 30-kw Lundell generator for Childs Dairy, Philadelphia; 7 by 9 vertical automatic engine direct connected to 12½-kw Bullock generator ordered through the Chicago office; 12 by 12 horizontal automatic engine direct connected to 50-kw Northern electric generator for the Eagle Tannery Company, San Francisco; 13 by 12 vertical automatic engine direct connected to Thresher generator and 10 by 12 vertical automatic engine direct connected to Thresher generator for Fort Hamilton, N. Y.; 8 by 9 vertical automatic engine direct connected to 15-kw Eddy generator for Furst Brothers; 6½ by 7 vertical automatic engine direct connected to Eddy generator for Jamestown & Newport Ferry Company, and 8 by 9 vertical automatic engine direct connected to Eddy generator for M. T. Hudnor, Fall River, Mass. The company's recent contract for Worthington boilers include two 142-hp boilers, being the third order received for installation in the Grand Union Hotel, Forty-second Street and Park Avenue, New York City; one 200-hp boiler for Worcester & Hampshire Street Railway Company, Ware, Mass.; one 70-hp and one 102-hp boiler for Fort Hamilton, New York; one 67-hp boiler for F. D. Cummer & Son Company, Cleveland, Ohio; four 360-hp boilers for Michigan Construction Company, Jackson, Mich.; two 50-hp boilers for Childs Dining Hall Company, Philadelphia, Pa., and one 104-hp, one 152-hp, also one 168-hp boiler for use in Hotel Wellington, New York City.

ELECTRIC TRACTION IN MEXICO.—The prosperous State of Yucatan, Mexico, will soon have two important electric traction systems, which will mark the first introduction of electrical motive power into that region. The city of Merida, capital of the State, in which some 50 miles of mule tramways are at present operated, has granted a concession to Arturo Castillo Rivas, of that city, for the purpose of constructing a network of trolley lines. The existing horse roads are to be done away with. The power house, etc., for the projected road, will, it is estimated, mean an expenditure of some $200,000. H. H. Barnes, of Barnes Brothers, of this city, who has largely financed various industrial enterprises in that part of the world, has been approached with a view to his securing an interest in the enterprise. The other project referred to applies to the flourishing city of Progreso, which is the principal port of Yucatan from where some 500,000 bales of sisal hemp, constituting a cargo for about 200 vessels, were shipped last year to the United States. The wharf facilities are now being largely extended, and the Compania del Ferrocarril Muelle y Almancenes del Comercio de Progreso (the Railroad, Wharf & Warehouse Company, of Progreso) is about to incorporate a subsidiary company for the purpose of converting the present mule road—about 8 miles in length—into electricity, and to considerably extend the lines now in operation. The company also proposes to operate all the machinery on the docks by electricity, and also to light the town. Menalio Martin, manager for Jose Gabriel Escalante, which concern is agent for the Ward line steamships at Progreso, is primarily interested in the scheme. This gentleman is at present in New York, and can be found at the Chelsea, 222 West Twenty-third Street.

TROLLEY IN MANILA.—Negotiations leading up to the conversion of the Manila horse tramways into electric power, to which reference has been recently made in these columns, have now been concluded, and G. B. Hopkins, representing American capitalists, has acquired the franchise of the Manila Street Railway Company. English and German parties are said to have made considerable efforts to complete arrangements with the Manila Company. It is anticipated, according to private advices from Manila, that no time will be lost in drawing up specifications, etc., relative to the conversion of the lines, and that contracts for material equipment, etc., will be given out very shortly. All the contracts will, of course, be placed in the United States.

THE HAVANA ELECTRIC RAILWAY COMPANY, which concern continues to place considerable contracts for material, equipment supplies and so forth, in this market, has just forwarded a miscellaneous order valued at some $35,000, to the Morris Electric Company, of New York City. The order calls for the shipment of a $10,000 lot of leaded case 500,000-cm cable; overhead material including frogs, switches, ears, insulators and span wire; 1500 barrels of cold tar, several hundred barrels of grease oil and a varied lot of general supplies.

PECKHAM TRUCKS FOR SIAM.—The Peckham Truck Company, of Kingston, N. Y., has obtained a contract from the Bangkok Electric Railway Company, of Bangkok, Siam, for the furnishing of 26 single trucks. The domestic business of the company is stated to be in an exceedingly flourishing condition, over 1000 trucks being now under construction. Among the principal contracts is one for 157 single trucks of the Metropolitan special type, which are to be supplied the Pittsburg Consolidated Traction Company. The value of this order is reported to be about $44,000.

COUNTY LIGHTING PLANT.—The Cuyahoga County Commissioners at Cleveland, Ohio, have decided to erect a private lighting plant for lighting the county buildings. Plans and specifications prepared by George S. Ryder, a local engineer, have been approved, and bids on the equipment will be received up to June 5. The plant will cost about $10,000.

PARSONS TURBO-GENERATOR.—Westinghouse, Church, Kerr & Co., of New York City, have secured an order for a Westinghouse-Parsons turbo-generator of 400 kilowatts, which is to be installed in the plant of the Yale & Towne Manufacturing Company, Stamford, Conn.

ENGINES.—The Norfolk Coal & Coke Company, Maybeury, W. Va., has purchased two 450-hp engines from the Ball Engine Company, Erie, Pa.

NEW POWER HOUSE.—Plans for a large power house to be built in Cambridge, Mass., have been prepared by Messrs. Sheaff & Jaastad, of Boston.

THE ALSEN CEMENT COMPANY, West Camp, N. Y., has ordered a 200-hp tandem compound engine, arranged for direct connection to the generator, from the Ball Engine Company, Erie, Pa.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended May 15: Antwerp—1 case electrical machinery, $125; 46 cases electrical material, $6,750. Athens—60 packages electrical material, $5,309. Alicante—18 cases electrical material, $398. Argentine Republic—16 cases electrical material, $871; 5 packages electrical machinery, $1,015. British East Indies—69 packages electrical material, $2,138; 14 packages electrical machinery, $625. British Australia—179 packages electrical material, $8,540; 32 packages electrical machinery, $19,205. Brazil—7 packages electrical machinery, $856; 26 packages electrical material, $1,040. Berlin—1 package electrical material, $20. Barcelona—26 packages electrical material, $594. British West Indies—1 case electrical material, $10. Cuba—61 cases electrical material, $437. Cadiz—14 packages electrical material, $200. Chili—16 packages electrical material, $346. Central America—212 packages electrical material, $744. Dublin—4 cases electrical material, $59. Dutch West Indies—13 packages electrical material, $260. Dutch Guiana—1 case electrical material, $25. Dunkirk—1 case electrical machinery, $125. French West Indies—1 case electrical material, $12. Glasgow—30 packages electrical material, $8,764; 2 cases electrical machinery, $60. Gijon—2 packages electrical material, $117. Havre—19 packages electrical material, $946; 12 packages electrical machinery, $66. Hayti—1 crate bicycles, $18; 2 cases electrical material, $58. Helsingfors—3 packages electrical machinery, $773. Hamburg—$50 packages electrical material, $4,316. Liverpool—289 cases electrical material, $16,848; 159 cases electrical material, $4,747. London—522 packages electrical machinery, $70,658; 149 packages electrical material, $6,366; 85 rolls electric cable, $29,646; 21 motor cars and parts, $4,950. Munich—1 crate electrical machinery, $500. Manchester—8 packages electrical machinery, $1,000; 3 packages electrical material, $173. Marseilles—8 cases electrical material, $262. Mexico—63 cases electrical material, $1,082. Norwich—1 case electrical machinery, $300. Nova Scotia—21 packages electrical material, $273. New Foundland—10 packages electrical material, $251. New Zealand—15 packages electrical material, $832; 3 packages electrical machinery, $372. Newcastle—3 cases electrical machinery, $500. Peru—103 cases electrical material, $9,241; 16 packages electrical machinery, $1,522. Riga—5 packages electrical material, $1,779. Southampton—1 case electrical material, $20. U. S. Colombia—14 packages electrical material, $330; 40 packages electrical machinery, $2,000. Venezuela—35 packages electrical material, $527.

ELECTRIC POWER IN SUGAR FACTORY.—The United Fruit Company's sugar factory at Banes, Cuba, which has just been completed, is equipped with electrical machinery for operating everything in connection with the plant with the exception of the crushers. Charles Buckland, the chief engineer for Hugh Kelly, the well-known sugar expert, who undertook the contract for the entire plant, recently returned from Cuba, and states that the electrical installation is the largest ever utilized in sugar plantations in that part of the world. The electrical future of the contract, which was awarded to Percival R. Moses, E. E., of this city, consists of three simple automatic high-speed horizontal center-crank engines of 160 ihp each. These engines were built by the Ridgway Engine & Dynamo Company, of Ridgway, Pa. The generators of which there are three 100-kw machines, are built as well as all the motors used in the plant by the General Electric Company. They are direct connected to the engines. Following are the various purposes for which the motors are used. The crystallizers, which are on the second floor of the boiler house building, are worked by a motor of 15 horse-power. These crystallizers are 10 in number, 6 ft. 6 inches in diameter by 17 ft. long, and are geared down so as to give one revolution in 12 minutes. The salt-water equipment, supplied by Thomas A. Lewis, of New York City, which has a capacity of 4,000,000 gallons a day, is operated by two 50-hp motors. A 3-hp motor is utilized for driving the apparatus used for cleaning the juice. The motors are connected by wire with the main switchboard, and the electric plant is driven from the general battery consisting of 2400-hp Climax boilers, built by the Clonbrock Boiler Works, Brooklyn. The factory is lighted with 500 incandescent and 25 arc lights, furnished as well as is the wiring by Lowe & Leveridge, of New York City. The working of the electrical equipment is stated to be such a success that contracts for further apparatus required for an extension of the company's operations will be determined on in the near future.

BANNER YEAR FOR EXPORTS.—April's figures, as reported by the Treasury, maintain the expectation held out at the end of the nine-month period of a splendid year for American commerce. Already, at the close of ten months, the excess of exports over imports is $584,212,306. Assuming that the exports will drop a little in May and June, as they did last year, the total of exports for the fiscal year will be about $1,500,000,000, and the imports will scarcely reach $800,000,000, making a total commerce of $2,300,000,000, and an excess of exports over imports of $700,000,000. This will give a lower increase in the total commerce than that reported for several preceding fiscal years, but an excess of exports $85,000,000 greater than the hitherto banner year of 1898. The gain in total commerce from 1897 to 1898 was $21,800,000, in round numbers; from 1898 to 1899, it was $76,539,000; from 1899 to 1900, it was $320,000,000, while the increase from 1900 to 1901, now promises to be about $55,500,000. The gain in exports over last year seems likely to be fully $200,000,000.

THE UNITED STATES ELECTRICAL MANUFACTURING COMPANY has been organized in Butler with ex-Postmaster John W. Brown as president of the corporation; M. A. Berkimer, vice-president; W. H. Miller, secretary, and C. A. Bailey, treasurer. The company is incorporated under the laws of New Jersey and capitalized at $100,000, with authority to increase the capital stock to $500,000. The company will erect a plant in Pittsburg for the manufacture of electrical supplies, and engage in the business of building telephone systems. One of the branches of the business will be the manufacture of an electrical appliance which, it is asserted, will revolutionize the cost of building telephone systems. By its use, the central stations in small towns can be done away with and the cost of wiring reduced to about one-third of the systems in present use. One wire can be made to do duty for 25 telephones, and the mechanism is so arranged that any number on the wire can be called without ringing up the other telephones on the line.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., has found it expedient, in order to take better care of its large southern trade to establish another sales office in the South, this one at Winston-Salem, N. C. Mr. F. A. Barr is district manager. The Stanley Company's other Southern office is at Rock Hill, S. C., in charge of Mr. F. C. Whitner. The Stanley Company has now, besides the two mentioned above, branch sales offices located as follows: 71 Broadway, New York City; Equitable Building, Boston, Mass.; 26 South Fifteenth Street, Philadelphia; 31-33 New Montgomery Street, San Francisco, Calif.; Pioneer Building, Seattle, Washington, and Madison, Wis.

CEDARBURG'S NEW PLANT.—A. M. Patitz, of Milwaukee, Wis., is consulting engineer for an electric lighting plant to be installed at Cedarburg, Wis. Two 60-kw Warren induction type alternators, direct connected to Skinner engines, will constitute the generating machinery. A complete switchboard will distribute power to 35 series alternating-enclosed arc lamps and 1200 incandescent lamps. It is expected to have the plant in operation by July 1 of this year.

J. HOLT GATES & CO., 15 Monadnock Block, Chicago, Ill., are installing for Armour & Co., at New Orleans, La., two Triumph dynamos, 100-kw and 30-kw capacity, direct connected to two medium-speed engines. A fine switchboard will also be furnished in connection with the plant. Armour & Co. do a very large distributing business from New Orleans, and this plant will light and furnish power for the depot there.

THE CHRISTENSEN ENGINEERING COMPANY, Milwaukee., Wis., will enlarge its power plant. The company has contracted for a new direct-connected generator outfit. This unit will consist of a 400-kw, 250-volt Crocker-Wheeler generator, direct connected to an Allis-Corliss horizontal engine running at 100 r. p. m. This unit will be the first of its type in Milwaukee.

NEW AUTOMOBILE PLANT.—The question of selecting a location for the plant of the Church Automobile & Specialty Company is now under consideration. Mr. W. A. Church, Pittsburg, Pa., is president. New Castle, Pa., and Youngstown, Ohio, are mentioned in connection with the location of the proposed works.

EXTENSION OF WORKS.—The George V. Cresson Company, Philadelphia, Pa., manufacturer of power-transmitting machinery, will build an addition to its stock house. The new structure will be 50 by 344 ft. in dimensions.

DEPARTMENT STORE GENERATORS.—The Milwaukee Electric Company has been awarded the contract for the generators for Kroeger Brothers' department store. One 75-kw generator and one of 40 kilowatts will be direct-connected to Ideal engines.

THE AMERICAN BRIDGE COMPANY will furnish the Atchison, Topeka & Santa Fe Railroad with a red rock cantilever bridge over the Colorado River. It will also furnish two deck plate girder spans for the Nacozari Railroad Company, of Mexico.

THE GENDER & PAESCHKE MANUFACTURING COMPANY, Milwaukee, Wis., will add a 100-kw, direct-current, direct-connected unit to its present electric power plant.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., has recently shipped one of its new process noiseless pinions to Germany to be used on the private yacht of Emperor William.

EXTENDING ITS SHOPS.—The Card Electric Company, Mansfield, Ohio, is building an addition to its main shop.

General News.

THE TELEPHONE.

WATERBURY, CONN.—The Waterbury Automatic Telephone Company, which voted to go out of existence because of the new law making it necessary for independent telephone companies to apply to the Superior Court for a charter, held another meeting recently and decided to continue the organization.

ANITA, IA.—The Rural Telephone Company, of Anita, has been incorporated; the capital stock is $10,000. M. N. Baker, C. D. Robinson, L. B. Johnson, C. H. Dewald and Abe Bigg are the incorporators.

YATES CITY, ILL.—The People's Telephone Exchange, of Yates City, has been incorporated; capital stock, $2,000. Incorporators: W. G. Lehman, O. B. West and L. D. Fletcher.

POLO, ILL.—The Independent County Telephone Company, of Polo, has been incorporated; capital stock, $20,000. Incorporators: B. W. McHenry, W. P. Graham and A. B. Sheadle.

CHICAGO, ILL.—The Telephone Auxiliaries Company has been organized in Chicago, capital, $10,000, for the purpose of manufacturing telephones and electrical devices. Incorporators: H. P. Young, Nathan S. Smyser, E. J. Wilber.

MOUNT VERNON, ILL.—At the annual meeting of the stockholders in the Southern Illinois Telephone Company, the old board of directors was re-elected for another year, and the following officers chosen: Albert Watson, president; Walter Watson, secretary; O. M. Waters, treasurer.

INDIANAPOLIS, IND.—Considerable inquiry has recently been made concerning the two telephone companies operating in this city. Each was granted a twenty years' franchise, of which sixteen are yet to run, and each pays the city an annual tax or franchise fee of $6,000.

SPENCER, IND.—Three telephone companies are competing for business in this city. The Spencer Telephone Company has long distance connection with the new company at Indianapolis and the Farmers' Co-operative Company has an exchange. Each of the local companies has about 100 subscribers and there are 600 telephones in the county connected with them. Spencer business houses are using three telephones and the companies are seeking more business at low rates. The Farmers' Company has had a rapid growth in the country districts owing to the cheapness of its service to members. The rivalry between the companies is growing.

CEDAR, IOWA.—The Union Telephone Company, Cedar, has been incorporated. Capital stock, $10,000. Incorporators: C. Bradley, R. E. Halloway, James L. Moore, M. H. Picken, O. W. Moore, Wm. Abegg, J. W. Garvin, A. Jay Fairchild, R. J. Woody.

CYNTHIANA, KY.—Construction has commenced on a telephone line to be built exclusively for the accommodation of farmers here. A separate exchange will be established.

BALTIMORE, MD.—A rate war is on here between the Chesapeake and Potomac, a Bell Company, and the Hane Telephone Company, and the former is placing telephones in stores and residences on consideration of one call a day at five cents. The Hane Company promises something better than this. Each company has solicitors all over the State.

BALTIMORE, MD.—The Atlantic Wireless Telegraph & Telephone Company has been incorporated by Richard P. Simpson, Robert E. Lee Cunningham, Harry B. Cook, Willard F. Taylor, William I. Cook, Charles H. McDonnell and William Byrne. The stated capital stock is $5,000,000. It is said that the promoters have the rights for the Marconi system in Maryland, the Virginias and the Carolinas.

BALTIMORE, MD.—A contract has been signed by which the Maryland Telephone & Telegraph Company will install for the United Railways & Electric Company a private exchange with 93 stations. The same company has the contract to supply a private exchange for the use of the various departments of the city government with 120 stations. The company has just issued a new book of subscribers. The book contains a list of nearly 4000 subscribers.

MEXICAN TELEPHONE COMPANY.—The Mexican Telephone Company reports for March:

	1901.	1900.	Changes.	
Gross earnings	$17,204	$14,632	Inc.	$2,572
Operating expenses	11,127	9,731	Inc.	1,396
Net earnings	$6,077	$4,901	Inc.	$1,176
Subscribers	3,549	3,129	Inc.	420

Subscribers gained since March 1, 48.

ALMA, MICH.—The Union Telephone Company is enlarging its plant here. Fifty new telephones are being added, new and higher poles are being substituted for the old ones, and new switchboards are being put in. The total number of telephones at present is 185.

DETROIT, MICH.—The People's Telephone Company has contracted for $100,000 worth of telephone poles, nearly all Michigan timber. It will require 800 cars to bring the poles to Detroit, or twenty trains of forty cars each.

WABASH, IND.—Dayton Harter, of North Manchester, and Lewis Signs have obtained from the Wabash county commissioners a franchise covering the highways of the entire county for telephone toll lines. They are interested in a new exchange at North Manchester.

PRINCETON, MINN.—The Minnesota Rural Telegraph Company of Princeton, capital stock $50,000, has been incorporated by L. Rust, E. L. Saxon, C. T. Johnson, of Princeton; L. Ericskson and A. E. Westling.

MINNEAPOLIS, MINN.—W. R. Baumbach, of Wadena, is president of the new Iron Range Electric Telephone Company, which has organized with a capital stock of $50,000 to construct or purchase telegraph and telephone lines and exchanges. The headquarters will be at Wadena. The other directors are A. B. Kerlin, Park Rapids; W. J. Power, Hibbing; Clifford W. Baumbach and Albert M. Baumbach, Wadena. The Crookston Telephone Company has transferred its lines and entire system and franchise to the Iron Range Electric Telephone Company.

ALBANY, N. Y.—The Batavia Home Telephone Company has been incorporated, with a capital of $160,000, to operate a telephone line in Genesee County, with Batavia as the central point. The directors are Samuel B. Rawson, Addison B. Lord, of Elyria, O.; Alfred R. Smith, of North Tonawanda, and George C. Frost, of Buffalo.

SARATOGA, N. Y.—The Saratoga Telephone & Telegraph Company, of Saratoga Springs, has been incorporated to operate telephone lines in and between Saratoga Springs, Ballston Spa, Mechanicville, Stillwater, Waterford, Troy, Schuylerville, Glens Falls and Schenectady and other places. The capital is $125,000, and the directors are: Frederick H. Beach, Stephen C. Medbery, Irving W. Wiswall and Herbert C. Westcott, of Ballston, and Charles W. Cool, W. Levis Burk and William F. Bentley, of Glens Falls.

HURON, OHIO.—The Huron County Telephone Company is building a line to Berlin Heights.

NAPOLEON, OHIO.—The Napoleon Telephone Exchange has been succeeded by the Henry County Home Telephone Company.

WESTON, OHIO.—The Weston & Grand Rapids Telephone Company is preparing to build farmers' lines. The local exchange is to be enlarged.

WESTON, OHIO.—The Weston Mutual Telephone Company has been organized to build a local exchange. I. B. Ballmer is president and Edward Guyer, treasurer.

DAYTON, OHIO.—The Dayton & Troy Electric Railway Company has amended its charter to enable it to conduct telephone and electric lighting business in towns reached by its road.

CLINTON, OHIO.—The Akron People's Telephone Company will establish an exchange in this place. A good list of subscribers has been secured, and the exchange will start with 100 lines.

ANDOVER, OHIO.—The Andover Telephone Company is building a line to Espeyville, which will give connection with Linesville, Conneautville, Jamestown and other points in Pennsylvania.

CHILLICOTHE, OHIO.—The city council has voted to grant a franchise to the Ohio Telephone & Telegraph Company. The rate is limited to $2 for business houses and $1.50 for private residences per month.

ARCADIA, OHIO.—The Findlay Home Telephone Company has secured a franchise to build an exchange in this place. The Central Union Telephone Company has also secured a franchise, and will build a sub-exchange connecting with the Fostoria exchange.

CLEVELAND, OHIO.—The United States Telephone Company is about to inaugurate a one-minute long-distance service in order to meet the competition of the Bell companies. The rates have been fixed at a trifle more than half what is now charged for three-minute service.

SPRINGFIELD, OHIO.—The Home Telephone Company, of this city, which has been organized by David F. Snyder, of this place; Edward Dun, of Columbus, and Cleveland people, has applied for a franchise for a local exchange. This is one of the few large towns in Ohio which has no independent exchange.

COLUMBUS, OHIO.—Mr. Gustav Hirsch, who has been superintendent of construction for the Columbus Citizens' Telephone Company, has been appointed assistant superintendent and engineer for the Detroit, People's Telephone Company of Detroit. Both companies are controlled by the Federal Telephone Company of Cleveland.

TOLEDO, OHIO.—The Great Lakes Towing Company has opened an office at Huron Harbor. One tug will be on duty there at night and she will have on board a telephone. The line will be attached to the dock, and when the tug is tied up a connection will be made. When the tug goes out to make a tow the telephone line will be cast off with the shore hawser. The same sort of an arrangement has been made at the Soo, at Fairport and at Erie.

MANSFIELD, OHIO.—At the instigation of N. C. Manner and H. T. Manner, stockholders of the company, Judge Wolf has granted a temporary injunction restraining the officers of the Farmer's Co-operative Telephone Company from making an assignment or from disposing of the company's property. The company sold out some time ago to the Star Telephone Company, and the latter in turn sold to the Federal Telephone Company, of Cleveland.

CLEVELAND, OHIO.—General Manager H. E. Presson and Secretary C. C. Deering, of the Trans-Mississippi Telegraph & Telephone Company were in Cleveland recently to secure pointers to assist in the establishment of long-distance telephone lines in Nebraska. It is proposed to build lines from Omaha to Davenport, 300 miles, and from Dubuque to Sioux City. The Trans-Mississippi Company has a nominal capitalization of $100,000, and it is expected that this will soon be increased to $1,000,000.

CADIZ, OHIO.—The Harrison County Telephone Company will open its exchange in this city in the near future. The construction work is being done by the Independent Construction Company, of Archbold, Ohio, and the switchboard and other apparatus is being furnished by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. Connection will be made with a number of branch exchanges in this county, and long-distance service will be given over the lines of the United States Telephone Company. Ralph Cunningham is president of the company and W. W. Wright, secretary.

CLEVELAND, OHIO.—The United States Telephone Company has inaugurated its one-minute long-distance telephone service in this State. Heretofore the rate between Cleveland and Columbus has been 70 cents for three minutes or less, and 15 cents for each additional minute. The new rate is 40 cents for one minute and 15 cents for each additional minute. The company will establish a system of making appointments over its lines. Engagements will be made by the use of what are called order wires, without extra charge. It is expected that this service will prove a great benefit both to the company and the public.

TORONTO, ONT.—Ald. Urquhart, of Toronto, announces that he has a proposition for the establishment of a telephone service in Toronto. The company, which is to be incorporated as the Ontario Telephone Company, is said to be an offshoot of a successful United States company, operating exchanges in Wilkesbarre and Scranton, Pa. Local capital will be interested in the new enterprise. The new concern offers to give an efficient modern service for $36 for business houses and $25 for residences, or $50 for both to the same subscriber.

SHARON, PA.—The Bell Telephone Company has served notice on its subscribers at Sharon, Pa., that the rates will be raised after June 1. The Bell has no opposition in Sharon.

POTTSVILLE, PA.—A deed conveying the lines of the Schuylkill Telephone Company to the United Telephone & Telegraph Company, has been placed on record. The consideration was $218,750.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company, which controls the Allegheny County Telephone Company of Braddock, has decided to rebuild the entire system of the latter company. About $50,000 will be spent. The Braddock system will not be connected with Pittsburg for several months.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company is installing an automatic telephone toll service that promises to be popular, on account of its low prices, 5 cents for a three-minute message to any part of the two cities. A list of additional subscribers issued by the company showed 1,600 new instruments added in less than three months, making a total of 4,800 in the two cities.

GOURDIN, S. C.—The Gourdin Telephone Company has been commissioned with $1,000 capital.

GAINESBORO, TENN.—The Gainesboro Telephone Company, of the Georgia Division, has completed a long distance connection to Tallapoosa, Ga.

RICHARDSON, TEXAS.—The Richardson Telephone Company, of Richardson, has been incorporated. Capital stock, $750. Incorporators: C. H. Blewett, W. N. Stutts, C. C. Buffhines and others.

KEMP, TEXAS.—The Texas Telephone & Telegraph Company, of Kemp, Kaufman County, Texas, has been incorporated; capital stock, $20,000. Incorporators: George Mason, A. J. Still, Jr., J. W. Young, J. G. Crawford and E. O. Jones.

SAN ANTONIO, TEXAS.—The Commercial Telephone Company, of San Antonio, has been incorporated; capital stock, $500,000. Incorporators: Z. B. Campbell, H. M. Aubrey, of San Antonio, J. E. Boynton, Waco; C. M. Haskell, Ottawa, Ohio.

WAXAHACHIE, TEXAS.—A local telephone company to connect the towns of Ray, Howard, Nash, Maloney and Avaton with Waxahachie has been organized here. The name is the Ellis County Telephone Company, and the capital stock is fixed at $2,000.

TYLER, TEXAS.—The Tyler Telephone Company, of Tyler, has been incorporated. Capital stock, $40,000. The incorporators are S. F. Richardson, Z. B. Campbell, of San Antonio; M. D. Shaw, of Wapakoneta, Ohio; J. W. Wright, of Tyler; James S. Brailey, of Wauseon, Ohio, and James King Duffy, of New York City.

NEWPORT NEWS, VA.—The deal by which the Hampton Telephone Company was absorbed by the Long Distance Telephone Company of Virginia has been consummated.

ELECTRIC LIGHT AND POWER.

SELMA, CALIF.—The Selma Light & Water Company has been incorporated, with Selma as the place of business. Directors: E. Dudley, T. B. Matthews, J. Brownstone, C. Batchtold, S. Sewald, W. H. Shafer and D. S. Snodgrass. Capital stock, $100,000; subscribed, $4,000.

VENTURA, CALIF.—It has been officially announced that the Santa Ana Water Company and the Ventura Land & Power Company have been absorbed by the Ventura Water, Light & Power Company, with its principal place of business in Los Angeles. The capital stock of the new company is $500,000. The directors are: James H. Adams, Thomas W. Phillips, Theodore W. Brotherton, John M. Gardiner, Frank E. Trask, Los Angeles; William R. Staats and Jared S. Torrance, Pasadena.

SAN FRANCISCO, CALIF.—The San Joaquin Electric Company has received permission from the General Land Office, Washington, D. C., to resume construction work on its new reservoir in the Sierras in Crane Valley, Madera County, Calif. It is about one year since work was stopped by Federal orders because the site was on Government land. The artificial lake, which will cover an area of 350 acres, is located about 10 miles above the electric power station on the North Fork of the San Joaquin River, and will be used to impound water for the dry season.

SAN FRANCISCO, CALIF.—The Ventura Water, Light & Power Company recently filed an application for a franchise. Under its provisions the company will be allowed to extend its pipe lines to Montaloo, Calif., and the Santa Clara River. The privilege is also asked to construct pole lines for electric light and power purposes, from Ventura to Nordhoff, Montaloo, Oxnard, Huenerne, Saticoy and Santa Paula. It is said that the new company intends to build up an extensive electric light and power system, and that new electric railway lines will also be constructed.

ALBANY, GA.—At a meeting of taxpayers and others in the town of Albany it was decided to call an election on the question of a $25,000 bond issue to be used in installing an electric plant.

ATLANTA, GA.—The Atlanta Railway and Power Company, of Atlanta, is preparing to place underground in conduits its electric light wires within the fire district. Two carloads of conduits have been received.

THOMASTON, GA.—The Bibb Manufacturing Company has contracted to furnish power to the town of Thomaston for its new electric light system to be installed. Water power three miles distant will be developed. The company will also supply power to the Thomaston cotton mills.

ATLANTA, GA.—The Atlanta Board of Electrical Control has decided to recommend to Council that the Atlanta Railway & Power Company be allowed to run wires from its trolley wires to business houses in order to do the lighting until Oct. 9, when all wires, with the exception of trolley wires, must be placed underground.

SPRINGFIELD, ILL.—The Robinson Water, Light & Heat Company, of Robinson, has been incorporated. Capital stock, $70,000. Incorporators, C. S. Jones, Frank Barnes and A. H. Bayston.

FREEMONT, IND.—The town board has taken steps to build an electric light plant.

INDIANAPOLIS, IND.—City Engineer Jeup has completed the specifications for the new electric light contract and will present them to the board of public works, and the same will be open to bids.

BEDFORD, IND.—The Bedford Electric Light & Power Company has completed its organization by electing J. W. Cosner president, and J. R. Voris secretary. The contract price for the plant is $35,000 and is placed with the A. J. Stohl Company, of Laporte, and H. W. Shoot, of Chicago.

MARION, IND.—The appointment of a receiver for the electric light plant at this place until it can be determined to whom the property belongs has been approved by the Supreme Court. The court said that the fact that the plant was solvent and yields an income of $2,000 a month, and that there seems likely to be a fierce and protracted litigation over its ownership justified the lower court in taking it away from both parties until the dispute was settled.

INDIANAPOLIS, IND.—An investigation reveals the fact that the Shelbyville Electric Light Company, capital $225,000; the Crawfordsville Electric Light Company, capital $300,000, and other corporations doing business in Indiana have all incorporated under the laws of the State of Maine. If these corporations file articles in Indiana, as the Secretary of State says they must, the total fees will amount to $616.30. Representatives of foreign corporations threaten to test the new corporation law.

WORCESTER, MASS.—W. H. Burns will install an electric light plant in his new underwear factory building to be erected here.

ALBERT LEA, MINN.—The Albert Lea Electric Light Company has increased its capital stock from $100,000 to $200,000.

ST. LOUIS, MO.—Bids were opened by the Board of Public Improvements May 15 for the installation of a municipal lighting plant for the several stations of the water works at Baden. They were referred to the water commissioner for computation and report. The president of the board also submitted the draft of an ordinance providing for the installation of a lighting plant in the new city hall to cost $47,000.

HELENA, MONT.—Work is now in progress on the extension of the Missouri River Power Company's water-electric plant, sixteen miles from this city. Large additions will be made to the electric equipment. The new plant will include ten generators; now there are only four. Electric energy will be transmitted to Butte. The improvements will cost about $1,000,000.

MILLVILLE, N. J.—The window glass plant which will be established here by Dr. T. C. Wheaton, will be lighted by electricity, and operated by gas. The plant will be 100 by 140 ft. in size, and will contain 30 blowing tanks.

TRENTON, N. J.—The American Falls Water Power Company, Newark, N. J., has been incorporated to generate power for lighting, heating, etc.; capital, $300,000. Incorporators: Edward C. Tracy, Frank A. Bridge, Clarence B. Wisner.

MT. VERNON, OHIO.—The village council has decided to submit to the vote of the citizens a proposition to build a municipal lighting plant.

CINCINNATI, OHIO.—The Union Light, Heat & Power Company, of this city will build an addition to its power house on Madison Avenue.

KENTON, OHIO.—Articles of incorporation for the People's Heat & Light Company have been filed. The company will have a capital stock of $100,000.

CLEVELAND, OHIO.—Mayor Tom L. Johnson, of Cleveland, is having estimates prepared on the cost of a municipal lighting plant to illuminate the entire city.

KENTON, OHIO.—The People's Heat & Light Company has been incorporated by local people with $100,000 to furnish electric light, heat and power. A plant will be built at once.

NILES, OHIO.—The Niles Electric Light Company has been incorporated by Wade A. Taylor, W. H. Pritchard, F. H. Wilson, Jr., Jean Kilpatrick and Robert Weiss. The capital stock is $25,000.

CINCINNATI, OHIO.—Electric contractors in Cincinnati have signed the new scale for an eight-hour day with a $2.50 pay scale for inside men, and a ten-hour day and $2.00 for outside men. The Electrical Union, which presented the agreement, threatened a strike if this scale was not adopted.

WAPAKONETA, OHIO.—The linemen employed by the Chicago Interstate Construction Company, which is building exchanges in this city and adjoining points, have struck for higher wages, and work is at a standstill. The linemen demand an increase from $2.25 to $2.50 per day and the ground men from $1.25 to $1.50.

CINCINNATI, OHIO.—The Lima, Ohio, Electric Light, Heat & Power Company has installed one of the largest engines in Ohio. It weighs seventy tons and is of 600-hp, and was built by the McIntosh & Seymour Company, of Auburn, N. Y. As soon as the machinery is put in place and started, all the arc lighting in the city will be replaced by enclosed arcs of the latest pattern.

CINCINNATI, OHIO.—City Electrician Weislederer in his annual report says the work of removing the overhead wires and placing them underground involves so much in the way of money outlay and engineering questions as to demand the services of a commission of capable men to prepare plans on a comprehensive scale suited to the needs of the city. The report states that during the year 106 new electric lamps were erected, making 3368 in existence December 31, 1900. The total cost of lighting the city during 1900 was $282,451.90.

GODERICH, ONT.—The Maitland River Power Company has been given a contract by the council for the town of Goderich to furnish electric light and power. The company will expend about $100,000 in building and establishing a power plant.

MONTREAL, QUE.—Tenders are invited by the city council of Montreal, Que., until June 15 for electric street lighting after the expiration of the present lighting contract. Particulars will be given by L. O. David, city clerk.

MONTREAL, QUE.—Messrs. Allan MacDougall, of Three Rivers; John Hyde, Edward Ronayne, and H. J. Harrison, of Montreal; Alex. Falconer, of Westmount, and James Galbraith, of Lachine, are applying to the Quebec government for incorporation as the Provincial Light, Heat & Power Company, with a capital of $500,000; the chief place of business is to be at Three Rivers, Que.

MONTREAL, QUE.—There is a probability of a lively war of rates for lighting in Montreal. The new combination known as the Montreal Light, Heat & Power Company, absorbed the Gas, the Royal Electric and the Chambly Electric companies, but failed to come to terms with the Lachine Rapids Hydraulic & Land Company. The latter company is now considering the advisability of going into the gas business.

MONTREAL, QUE.—The power at the head of Shiek's Island dam, at Cornwall, Ont., is being developed by Mr. H. P. Davis, from plans prepared by T. Pringle & Son, of Montreal. The power is to be utilized for operating the canal locks. It is understood that the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, has secured the contract for the building of the first of four three-phase generators to be installed.

MONTREAL, QUEBEC.—Manager Walbank, of the Lachine Rapids Hydraulic & Land Company, Montreal, announces that it is the intention of his company to tender for the contract for lighting the streets of Montreal. This contract is worth $250,000 per annum, at present, but the Lachine Electric Company will tender at a lower figure than ever before attempted in order to secure the contract. The company will shortly commence the erection of a steam power-house in the centre of the city to provide against contingencies and insure current for lighting purposes the year out.

MEXIA, TEXAS.—The Mexia Light & Power Company, of Mexia; capital stock, $16,000; has been incorporated by James R. Cravens, John H. Shelly and T. S. Miller, all of Dallas.

PARIS, TEX.—The Paris Transit Light & Power Company, of Paris, has been incorporated; capital stock, $250,000. Incorporators: W. B. Little, Robert H. Cornell, of St. Louis; W. F. Dulaney, R. W. Wortham and S. B. M. Long of Paris.

THE ELECTRIC RAILWAY.

FORT WAYNE, IND.—A new traction road between this city and Goshen is planned.

INDIANAPOLIS, IND.—The Indianapolis, Lebanon & Frankfort Electric Railway Company has filed bonds for construction and will begin work at once.

INDIANAPOLIS, IND.—The two companies that have announced their intention of building an electric road from here to Martinsville, over the same route, have each begun condemnation proceedings to obtain a private right of way.

BRAZIL, IND.—A company, headed by W. R. Risher, has applied to the county commissioners for a franchise to construct a traction line from this city ten miles north to Caseyville.

NEW CASTLE, IND.—The money for the construction of the electric line from this city to Muncie has been guaranteed and the work will be pushed to completion at once.

INDIANAPOLIS, IND.—The preliminary survey of the proposed electric line between this city and Crawfordsville is completed. The company has been incorporated with a capital of $100,000. The company announces that arrangements have been made to finance the road as soon as the estimates of the cost are completed.

NEW YORK, N. Y.—It is announced that the Broadway cable line of the Metropolitan Street Railway Company will cease to be operated by cable power at midnight on May 25. Electric power will then be substituted for the cable. This is the last cable road in New York. With the change of the Broadway line to electric power all of the great longitudinal roads in the city will be operated by this means. Some of the crosstown lines are also operated by electric power, and others are now being changed and rebuilt for the same purpose.

ALBANY, N. Y.—The strike of the employees of the Union Traction Company, which was noted in last week's issue, was brought to a close last Saturday, after a conference between representatives of the employees and the company. In the settlement concessions were made on both sides. The roads affected are now in regular operation. The old men, excepting those under arrest charged with violence, were reinstated. The relations between the company and its employees now seem to be better understood. During the strike the troops fired upon a crowd, resulting in the death of two prominent citizens, who had nothing to do with the rioting. The total cost of the strike, which lasted twelve days, is estimated at $68,943.03. This includes the losses to the men and the company and the cost of transportation and maintenance of the troops. The troops have all returned to their homes. The company's right to employ non-union as well as union men is recognized, the strikers get the increase in wages asked for, and it is agreed that no strike shall begin until six days after notice to the company. The agreement is binding upon employer and employed for three years.

BROOKLYN, N. Y.—General Manager Brackenridge, of the Brooklyn Rapid Transit Company said recently that a plan was in contemplation to provide a receiving dormitory, with cots, medicines and the best medical attendants, for the immediate aid of persons injured on the lines of the company. The plan is to fit up an unused building at Fifty-second Street and First Avenue, on the same lines as the ordinary emergency hospital and also to follow the idea adopted by the New York Central Railroad at Buffalo. Everything that pertains to a well equipped hospital will be placed in the building and an ambulance service by trolley will be provided.

COLUMBUS, OHIO.—The Columbus, London & Springfield Railway has decided to erect a power-house at Grant Quarries on Central Avenue.

MASSILLON, OHIO.—The village of Navarre has granted a 25-year franchise to the Canton-Masillon Electric Railway Company for an extension of the line to Navarre.

CINCINNATI, OHIO.—Chicago capitalists will advance the money necessary to build the Chillicothe-Hillsboro Traction Company's road. Dr. Charles Hoyt is president.

BOWLING GREEN, OHIO.—Robert Muir and John Geghan, of this place, are promoting an electric railway which is to run from Port Clinton to Fremont and Bowling Green.

WADSWORTH, OHIO.—Residents in this vicinity have offered a free right of way to the Northern Ohio Traction Company for a spur to Wadsworth from the new Barberton line.

URBANA, OHIO.—The Dayton, Springfield & Urbana Railway Company has applied to the commissioners of Champaign County for a franchise through the northern part of the county.

CANTON, OHIO.—The Canton-Akron Railway Company has applied for a franchise in Tuscarawas County. It is the intention to extend the line from Canton to Canal Dover and New Philadelphia.

LORAIN, OHIO.—It is stated here that several prominent local people, backed by Cleveland capitalists, are securing right of way for a second line from Cleveland to Lorain. The road will be built over private right of way.

ZANESVILLE, OHIO.—The city council has passed a blanket franchise granting to Col. Boone and associates, representing the Black Diamond Traction Company, the right to use practically all of the available streets of this city.

CLEVELAND, OHIO.—The Cleveland, Ashland & Mansfield Traction Company, of which F. T. Pomeroy, of the Cleveland, Elyria & Western Company is chief promoter, has secured a franchise enabling it to build into Ashland.

CINCINNATI, OHIO.—The Little Miami Traction Company, operating many short systems in southern and central Ohio into Cincinnati, will introduce the third rail system on its proposed line from Yellow Springs, Ohio, to Clifton.

CINCINNATI, OHIO.—Rights of way for the proposed electric railway to connect Cynthiana and Louisville, Ky., have been secured through Harrison, Bourbon, Scott, Franklin and Shelby Counties. The line will be eighty miles in length.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company has placed a contract with P. H. McSpadgen, of McKeesport, for building an extension of its line from the East End loop to Little Beaver Creek. Materials have been ordered.

WARREN, OHIO.—Manager A. A. Anderson, of the Mahoning Valley Railway Company, has asked the county commissioners for a franchise for a line from Warren to Leavittsburg. The Chagrin Falls & Eastern Railway Company, has applied for a similar franchise.

LORAIN, OHIO.—The Lorain & Cleveland Railway Company and the Sandusky & Interurban Railway Company, which are soon to be merged into the Lake Shore Electric Railway Company, have completed arrangements for operating through cars from Cleveland to Sandusky through this place.

CINCINNATI, OHIO.—The Dayton, Lebanon & Cincinnati Railway Company has been purchased by A. E. Appleyard, of Boston, principal owner of the Dayton, Springfield & Urbana Traction Company and other large electric railway interests throughout the State. The price paid was $250,000.

TOLEDO, OHIO.—The Toledo-Bryan Air Line Company has been incorporated with $1,250,000 capital, by Joseph L. Yost, Frederick V. H. Cillins, William C. Brewer, Milton Taylor, Joseph C. Bonner, John Q. Adams, John Schlotherg, George F. Miller and William P. Heston. The company, which was originally organized under another name, proposes to build an air line electric railway from Toledo to Bryan.

CLEVELAND, OHIO.—E. G. Tillotson, of the Cleveland Trust Company, and who is at the head of the local syndicate which has a 30-day option on the properties of the Cleveland & Chagrin Falls Railway, and the Chagrin Falls & Eastern Railway, states that the syndicate has been successful in financing the project, and that the properties will be turned over at once. This means a consolidation of the two roads with the Cleveland & Eastern Railway.

CORNWALL, ONT.—The Electric Street Railway Company has purchased a water power from the Cornwall Milling Company, and proposes utilizing the water power for the operation of its road. New dynamos and water wheels will be installed.

OTTAWA, ONT.—Boston, Mass., and Kingston, Ont., capitalists are interested in a proposed electric railway to radiate east and west from Kingston, and ultimately to cover the territory between Toronto, Cornwall and Ottawa. As soon as the company's organization is completed, the Ontario Government will be asked to grant the company a special act to enable it to get a charter.

OTTAWA, ONT.—One of the difficulties, in connection with the street car service in Havana, says Mr. Wm. M. Doull, the secretary-treasurer of the Cuban Electric Railway, of which Mr. A. F. Gault, of Montreal, is president, is the fact that they have no five-cent pieces to use. This has been overcome, but not satisfactorily. They have the peseta, which is equal to fifteen cents, and for this piece of money three tickets are secured. Mr. Doull was in Havana when the first section of the street railway was opened for traffic, and he states that the success, in the way of traffic, was even better than was ever anticipated. The first start made was on ten miles, and the company had not sufficient cars to accommodate the crowds that wanted to avail themselves of the new system of travel through Havana's streets.

LA CROSSE, WIS.—A strike of street car employees is imminent. They have made a demand for higher wages, and the officials of the company do not look on the demand with very much favor.

JANESVILLE, WIS.—The Janesville Street Railway Company is putting in a return circuit in compliance with an ordinance passed by the common council, as a means of protecting the underground systems of the Janesville Water Company and the electric light, gas and telephone companies, against electrolysis.

THE AUTOMOBILE.

THE WOODS VEHICLE COMPANY, to manufacture automobiles, has been incorporated in New Jersey, with a capital of $1,500,000. The incorporators are Alfred P. Brown, Edward B. Hawkins and Edward T. Mogoffin.

THE HAVERSTRAW AUTO-SERVICE COMPANY has been incorporated to operate a stage route in Rockland County through the towns of Haverstraw, Stony Point and Clarkstown; capital, $10,000. Directors: George P. Hilton and Hershel Roberts, Albany; Charles M. Hilton, Haverstraw.

THE ILLINOIS MOTOR TRANSIT COMPANY has been incorporated at Urbana, Ill., with a capital stock of $50,000. The shareholders are Allen Williams, A. J. Williams, M. L. Williams, John Armstrong and others. The company will establish a line of automobiles in Champaign and Urbana.

NEW INDUSTRIAL COMPANIES.

THE GARL ELECTRIC COMPANY, of Akron, Ohio, has been incorporated with a capital stock of $25,000.

THE ELECTRIC DISPATCH COMPANY, of Detroit, has been incorporated at Wilmington, Del., with a capital of $100,000.

THE ELECTRIC MOTOR AND GENERATOR VENTILATING COMPANY has been incorporated at Wilmington, Del., with a capital stock of $100,000.

THE NATIONAL ELECTRIC CLOCK COMPANY has been incorporated in Maine; capital stock, $300,000. President, Joseph S. Smith, of Bangor; treasurer, William W. Gile, of Boston.

THE M. K. C. ELECTRICAL SEPARATOR COMPANY has been incorporated at Denver, Col. Capital stock, $100,000. Incorporators: F. H. Kirby, J. M. McClave, E. R. Cumbe, William Colley.

THE UNITED ELECTRIC & MANUFACTURING COMPANY, of Cleveland, has been incorporated with $10,000 capital stock by Thomas Shehan, C. J. Estep, Ira Culver, M. F. Parrett and W. L. West.

THE G. & E. ELECTRICAL & CONSTRUCTING COMPANY, of Binghamton, N. Y., has been incorporated; capital, $12,000. Directors: W. H. Gaylord, Fred Eitapenc and E. Isherman, of Binghamton, N. Y.

THE NATIONAL ELECTRIC IMPROVEMENT COMPANY has been incorporated, with home office in Jersey City, N. J. Capital, $2,000. Incorporators: Charles N. King, Stephen C. Smith and Le Grand Bouker.

THE CENTURY ELECTRIC COMPANY was recently incorporated, with San Francisco as the principal place of business. Directors: L. D. Hitzeroth, S. H. Weidenthal, W. J. Nixon, F. H. Bates and W. D. Mackey. Capital stock, $50,000; subscribed, $125.

THE ELECTRIC MOTOR & GENERATOR VENTILATING COMPANY has been incorporated at Wilmington, Del., to manufacture, buy, sell, own and operate ventilating facilities for electric motors, generators and other improved devices. The capital stock is $100,000.

THE HEIL RAIL JOINT WELDING COMPANY has been incorporated at Milwaukee, Wis., by Y. P. Heil, R. J. O'Hara, J. B. Conrad and Charles Abrech. The company will do cast welding and other work pertaining to making a continuous rail. It is capitalized at $25,000.

THE DELAVAL STEAM TURBINE COMPANY, capital $1,000,000, has been incorporated at Trenton, N. J., to manufacture steam turbines, dynamos and other electrical apparatus. The company has exclusive control of a patent for turbine wheels operated by steam and is now building a large plant in Trenton.

THE AKOUPHONE COMPANY, of New York City, has been incorporated to manufacture instruments to enable the deaf to hear and the dumb to speak. Capital, $700,000. Directors: Benjamin H. Adams, Herbert W. Grindal, Henry D. McGowan, Charles W. King and David U. Jennings, New York City. The company's system employs an electric telephone of special construction.

THE THOMAS H. B. VARNEY COMPANY was recently incorporated, with San Francisco as the principal place of business. Automobiles, both electric and steam, will be handled on a large scale. Directors: T. H. B. Varney, L. D. Owens, E. I. Varney, C. C. Hopkins and H. Mortenson, all of San Francisco. Capital stock, $25,000; fully subscribed. The company will carry the agencies for the Waverley and other automobiles.

LEGAL.

DEFECTIVE LIGHTNING ARRESTERS.—The Supreme Court of Vermont has confirmed the judgment of the trial court in a case where a physician was killed by lightning while sitting in his library reading under a telephone. It was contended that the lightning entered the house over the telephone wire, and that the company was negligent in not providing proper lightning arresters. The evidence brought out the fact that there was a lightning arrester connected with the telephone, but that it was inoperative. The Supreme Court affirmed the judgment of the lower court in favor of the heirs of the physician.

SUIT TO RESTRICT PARTY LINES.—In the case brought by Supervisor McCarthy, of San Francisco, against Louis F. Glass, manager of the Pacific States Telephone & Telegraph Company, charged with violating the telephone ordinance by using more than five subscribers on a party line, a dismissal was recently granted on motion of the plaintiff's attorney. The reason for this action of the prosecution was that it had been discovered that, under the law, an individual could not be charged with the offense. A new warrant will be issued charging the corporation with the violation of the ordinance. There are many 10-party lines in use in the city, which have caused complaints.

UNDERGROUND WIRES IN MINNEAPOLIS.—The Supreme Court of Minnesota has sustained the contention of the Northwestern Telephone Company as to the telephone company's right to build overhead wires within the limits prescribed by the city of Minneapolis, Minn., in which wires shall be placed underground. The company ignored the ordinance and proceeded to string wires within the "underground limits." The work was stopped by the police, and the company applied for an injunction to restrain the city from interfering with the work. The injunction was demurred to by the city and the company appealed to the Supreme Court, which reversed the action of the lower court, but a rehearing was secured. The decision makes it necessary for the city to establish new limits for underground wires.

PERSONAL.

MR. C. A. COFFIN, president of the General Electric Company, sailed last week for Europe.

MR. E. C. BOYNTON, for the past five years electrical engineer with the New York, New Haven & Hartford Railroad, has been appointed mechanical engineer of the Chicago Great Western Railroad, with headquarters at St. Paul, Minn.

CLEVELAND ELECTRIC CLUB.—At the last monthly meeting of the Cleveland Electric Club, Professor W. E. Goldsborough, of Purdue University, presented a paper on "The relative desirability and efficiency of direct current and induction motors."

MR. J. GEISEROWICH, secretary and treasurer of the Alden Electric Company and Illinois Insulated Wire Company, of Chicago, was a visitor at our offices last week. He has been making an extensive Eastern trip in the interest of the above concerns.

MR. BAYARD L. KILGOUR, until recently electrical engineer of the Cincinnati Street Railway Company, has been appointed supervising engineer of construction and maintainance and supervisor of contracts of the City & Suburban Telegraph Association, Cincinnati, Ohio.

MR. R. E. DANFORTH has been appointed general manager of the Lake Shore Electric Railway of Cleveland, a consolidation of the Lorain & Cleveland, the Sandusky & Interurban and the Sandusky, Norwalk & Southern. He was formerly assistant superintendent of the International Traction Company of Buffalo. His headquarters are in Cleveland.

MR. F. STUART WILLIAMSON, consulting structural engineer, has entered into a copartnership under the firm name of Charles Henry Davis & Partners, with New York offices in the Broad Exchange Building, 25 Broad Street, New York. The other members are C. H. Davis, J. S. Griggs, T. W. Sprague, E. Vander Horst, E. G. Thomas and C. E. Pearce.

WIRELESS TELEGRAPHY.—Prof S. M. Kintner, of the Western University of Pennsylvania, on May 3 gave a lecture on "Wireless Telegraphy" at Carnegie Institute, Pittsburg, Pa. Mr. Henry W. Fisher, chief electrical engineer of the Standard Underground Cable Company, Pittsburg, also gave a lecture on "High Frequency Electric Currents." The lectures were delivered under the auspices of the Academy of Science and Art, and were illustrated by experiments.

EDUCATIONAL.

SUMMER COURSES.—The Massachusetts Institute of Technology has issued a pamphlet giving an outline of its courses for the summer of 1901. The supplementary series of courses of study will be given during the months of June and July. These courses are of private undertaking on the part of certain instructors, and they will only be given when a minimum number of students have applied at a fixed date. They have been undertaken primarily for the benefit of two classes of its students, first, those who wish to study in summer in order to gain more time for advanced work in their regular courses, and second, for those who through illness or other causes have deficiencies to make up.

Trade Notes.

THE PERU ELECTRIC MANUFACTURING COMPANY, of Peru, Ind., reports success for its new baby knife switch. The trade in general apparently approves of this new switch as readily as the National Board of Fire Underwriters.

BUSY DAYS.—These are busy days for the shipping force of the Electric Appliance Company, Chicago. While the demand seems to be for everything in the realm of electrical goods, the percentage of increase of sales of Adams-Bagnall arc lamps is leading the company's other specialties.

ELECTRIC FANS.—The Robbins & Myers Company, of Springfield, Ohio, recently made a shipment of a carload of its electric fans to Texas, the largest single shipment it has ever made. This department of the company's business has increased ten-fold since it was started, and a very heavy foreign trade is being worked up.

THE ROCHESTER ELECTRIC MOTOR COMPANY, Rochester, N. Y., in a neatly gotten-up pamphlet give a list of a few Rochester people with whom it does business. The pamphlet contains the names of 50 Rochester firms, representing different lines of trade, to whom the Rochester Motor Company has furnished its apparatus.

THE MONARCH ELECTRIC & WIRE COMPANY is the name of the new company which succeeds Samuel Mankowitz at 125 and 127 South Clinton street, Chicago. It is equipping a factory to manufacture the Monarch brand of weatherproof wire and will also conduct a supply store carrying a complete line of electrical supplies.

THE UNITED STATES WIRE CONDUIT COMPANY, New Kensington, Pa., is just completing its works whereby it is enabled to turn out the "Standard" interior and exterior flexible enameled conduit tubing. There is every evidence that this conduit will secure ready favor and the manufacturer is now desirous of securing agents in various parts of the country.

DIRECT-CURRENT POWER MOTORS.—The Falcon Electric Manufacturing Company, 432 East Seventy-first Street, New York, has issued a card circular giving dimensions, capacities, prices and other information of its direct-current high-speed, shunt-wound power motors. These machines are compact and have square bases, but round or oblong bases can be supplied.

TO REMOVE ITS BUSINESS.—The Dayton Fan & Motor Company, Dayton, Ohio, has received a proposition to remove its business to Ft. Wayne, Ind., and officials of the company are quoted as saying the change will be made within the next few months. The company has been troubled greatly with labor matters in Dayton, and for this reason it is desirous of making a change.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is receiving some nice orders for electric fixtures (chandeliers, brackets and portables). This company can furnish anything desired in this line of material, and is in a position to make prompt shipments. Before making shipments the Central Company is very careful to see that the goods are exactly as the customer ordered—a precaution which will be readily appreciated by purchasers of electric fixtures.

REMOVAL.—The Bordo Valve Company has moved its main office and works from Philadelphia to Coatesville, Pa. The company's new plant is thoroughly equipped with modern machinery and tools, and it is prepared to do strictly first-class work in brass casting and machine work. It carries a large stock of its regular Bordo plug valves and swing joints and can make prompt shipments. The company issues an illustrated descriptive pamphlet of its goods.

MECHANICAL DRAFT.—The B. F. Sturtevant Company, Boston, Mass., has no doubt been many times asked the question, "Who uses mechanical draft?" It undertakes to answer this question with a handsome 34-page pamphlet, in which is given lists of the large plants equipped by the company. The lists take up the entire pamphlet, and although they are only partially complete, they are long ones and include plants all over the civilized world. The title of the pamphlet is the question above quoted.

GRAPHITE BRUSHES.—The Joseph Dixon Crucible Company, Jersey City, N. J., is manufacturing a complete line of graphite brushes for motors, dynamos and generators. The company has issued a price list on the subject, in which it is pointed out that electrical engineers who have seen the commutators on which Dixon graphite brushes have been used for two or three years, have expressed great surprise at the slight wear of brushes and commutators and at the general perfect condition and freedom from burns and sparking.

MESSRS. CHARLES H. BESLY & CO., 10 North Canal Street, Chicago, Ill., report their general business very good. At this season of the year they are making large shipments of their Helmet oil, Bonanza cups and their new "Badger" oil cups, in which Helmet oil is used. At their factory at Beloit, Wis., they are very busy in their tap department, and are running night and day in their oil cup department. Their new 300-page illustrated catalogue is now ready for distribution, and will be mailed free to any address upon application.

SLIGHT FIRE DAMAGE.—The report that the plant of the Standard Telephone & Electric Company, Madison, Wis., was practically destroyed by fire recently was exaggerated. The company informs us that its plant was damaged to a small extent. No part of its machinery was lost and the only interruption was less than two day's duration, which was rendered necessary to enable an adjustment of the losses with the insurance companies. The business has not been interrupted and the fire will in no wise interfere with the work nor delay shipments.

FRICTION COUNTERSHAFTS AND ACCESSORIES constitute the subject of a circular just issued by the Garvin Machine Company, New York. The friction pulleys for these countershafts are lined with Ameledema oilless bearings, that require no oiling whatever, and they do not heat or cut the shaft. The Garvin Company is manufacturing these countershafts in large quantities with special machinery regularly manufactured by it. Illustrations are given of friction pulleys, standard hangers, friction pulley countershafts, a chucking lathe and a pulley polisher.

ELECTRIC SIGNS.—The A. & W. Electric Sign Company, of Cleveland, is building a number of large illuminated signs. One is for the Hershey Chocolate Company, of New York, which will be 76 ft. long and 26 ft. high at a cost of $2,500. It is also building two large signs for the Niagara Gorge Railroad Company at Niagara Falls. Large signs have recently been completed for the Cuyahoga Telephone Company, Scott Dry Goods Company, and other concerns in Cleveland. The A. & W. Electric Sign Company has been in business only a comparatively short time, but it is securing some excellent contracts.

INTERCOMMUNICATING TELEPHONE SYSTEM.—The Clark Automatic Telephone Switchboard Company, Providence, R. I., has issued a neat pamphlet of 24 pages, giving illustrations and brief descriptions of its automatic intercommunicating telephone system and apparatus. This apparatus has been thoroughly tested, and, it is stated, gives perfect service day and night. It is adapted for towns, factories, mills, warehouses, hotels, private residences, steamships and offices. The pamphlet contains a few copies of letters received by the company from users of its apparatus. They all speak in praise of the system.

MR. HENRY D. SEARS, of Boston, formerly for seven years with C. S. Knowles, and earlier with the General Electric Company, has established himself at 45 Arch Street as general sales agent for the Bellevue Porcelain Works, of Schenectady, N. Y. These works have been established for several years, but hitherto have devoted themselves to supplying porcelains to one or two large concerns. Now, however, they are open to orders from the general market, and Mr. Sears will handle their entire output. They make porcelains for electrical purposes only, and make a specialty of special pieces to order from drawings.

TO ENCOURAGE STUDY.—Twenty of the leading merchants and business men have agreed to allow any of their employes who become students of the International Correspondence Schools, Scranton, Pa., five evenings a week without reduction of salary in order that they may devote this time to their studies. Employers generally recognize the importance of educating their men, and in a number of the largest industrial plants in this country arrangements have been made for the accommodation of employes who wish to study by mail. On the recommendation of the Franklin Institute, the silver medal and diploma was awarded by the National Export Exposition to the International Correspondence Schools, Scranton, Pa., for a unique, thorough and comprehensive system of technical education by correspondence.

THE LEA ELECTRIC MANUFACTURING COMPANY.—This company's booth at the Pan-American Exposition is attracting attention, which is due largely to the ability and judgment of Mr. William M. Porter, manager of the company. Printed literature about the company's lamps and other products and souvenirs of the Northall lamp cover used by the company on its arc lamps can be obtained at the booth. Mr. Porter is one of the staff of the old Brush Electric Company, of Cleveland, Ohio, and has had 20 years' experience. The success of the Lea Company is due to his excellent management. The company's outlook is decidedly bright, and it is enjoying a large and rapidly growing business. It has outgrown its present facilities in Elwood, Ind., and contemplates moving to a larger city.

COLUMBUS STORAGE BATTERIES.—The Columbus Battery & Specialty Company, 25 N. Scioto Street, Columbus, Ohio, is placing on the market a new storage battery, which is stated to be the result of a long and careful series of experiments covering a period of many years. The plates are, according to the general catalogue of the company, made by an entirely new and superior process which, by chemical action, hardens the active material to the consistency of lime stone, the result of which produces a cell having high efficiency and low internal resistance. It is stated that the plates will not buckle, and that short circuits have no effect upon them whatever. Other important advantages are claimed for the battery. The catalogue just issued by the company gives a description and illustration of the battery.

FRINK REFLECTORS ABROAD.—I. P. Frink, 551 Pearl Street, New York, is not only lighting the finest department stores in this country, but is reaching out after foreign trade as well. Among the latest installations in the show window line are for the J. E. Manix Dry Goods Company, of Nashville, Tenn.; the show windows of the large department store of Senor Tomas Mendirichaga, Monterey, Mexico, who also used a large number of cluster reflectors for lighting the store interior with the most happy results, and also a large order for the show windows of one of the best known houses in Dublin, Ireland. The Frink reflector makes the ideal light for show windows. We might also call attention to the line of cluster reflectors manufactured by this firm for the lighting of store interiors, etc., which give a splendid light, make an exceedingly nice appearance, and are very durable.

IMPORTANT PATENT ON AUTOMATIC SWITCHES.—An important patent, No. 673,274, dated April 30, 1901, has been issued to H. Ward Leonard, which is claimed to cover very broadly all forms of motor starters and circuit breakers in which there are two arms, one of which responds to overload and the other of which responds to underload. These forms of double arm starters are known as "fool proof" starters, because they make it impossible for even the most careless or ignorant operator to cause any damage by improper manipulation of the apparatus. The patent contains twenty-one broad claims, of which we reproduce claim 6, which is a typical one: "In a circuit-controller, the combination of two movable switch members for controlling the same circuit, and two electroresponsive devices for controlling said switch members, each switch and its electroresponsive device operating automatically and independently of the other to affect the same circuit, one when excessive current flows and the other upon failure or abnormal decrease of current."

NEW TELEPHONES.—The telephone department of the Western Electrical Supply Company, of St. Louis, has just issued a number of bulletins covering its new telephones, switchboards, etc. These are bound up in catalogue form, and embrace everything pertaining to the complete equipment, construction or maintenance of a telephone line or exchange. They contain a large number of new devices for the economical operation of lines and exchanges, which have never been shown before. Among the new things noted is the company's loud-ringing extension gongs, developed in response to a demand for an extension bell to be used on telephone lines in noisy places; the adjustable arm, long-distance transmitter, with solid back; and new ideal bridging telephone, which embodies a number of new features. The catalogue also shows a very attractive looking receiver with a covered diaphragm. Any one contemplating installing a new exchange, or making additions and improvements of any kind, would do well to obtain a copy of these bulletins. They are mailed on application.

THE GOULD STORAGE BATTERY COMPANY, which has recently introduced a high-weight efficiency automobile battery, is being overrun with orders for the same. This new acquisition puts this enterprising company in a most advantageous position, for now it is supplying every vehicle requirement, including 40-mile delivery wagon batteries and 50-mile batteries for pleasure vehicles. It is a noteworthy fact that while these batteries are light of weight yet even so they are of the electro-chemical sort, in which the active material is "grown" out of the pure rolled plate after treatment by their ingenious "spinning process." The Gould No. 905 D battery weighs 18½ lbs. per cell, and gives an output of 100 ampere-hours. This is equal to 5½ amperes per pound, which for a 5-plate battery is remarkable, especially since the plates are not posted and are capable of withstanding a 100-ampere rate of discharge without damage to the plates. The Baker Company is using this company's battery in its remarkable runabout, and in Pittsburg the Gould is the only battery said to be capable of doing the "smoky way," which, as we all know, is an uphill job.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MAY 14, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

673,893. COLOR CHANGING AND SIGNALING DEVICE; H. M. Baker, Jr., and A. W. Fox, New York, N. Y. App. filed Aug. 8, 1900. An electro motive device by which the color disks in front of a calcium or similar light can be changed from a distance.

673,900. ELECTRIC BATTERY; D. H. Darling, Jr., New York, N. Y. App. filed Oct. 11, 1899. Details of a sealing device for the jar.

673,903. ELECTRIC CABLE; J. D. Goulf, Brooklyn, N. Y. App. filed April 6, 1898. The current carrying conductor has wound around it a fusible wire, which thereby acts in all parts of the circuit as a thermostat in case of over-heating from any cause.

673,910. CONTROLLER FOR MOTORS; C. W. Kragh, Madison, Wis. App. filed April 14, 1900. A construction by which the contacts can be made large and at the same time occupy a compact space.

673,911. POLYPHASE ALTERNATING-CURRENT MOTOR; B. G. Lamme, Pittsburg, Pa. App. filed Jan. 30, 1899. (See Current News and Notes.)

673,912 and 673,913. SYSTEM OF ELECTRICAL DISTRIBUTION; B. G. Lamme, Pittsburg, Pa. App. filed July 14, 1900. (See Current News and Notes.)

673,935. ELECTRIC LIGHTING SYSTEM; A. J. Wurts, Pittsburg, Pa. App. filed April 21, 1899. (See Current News and Notes.)

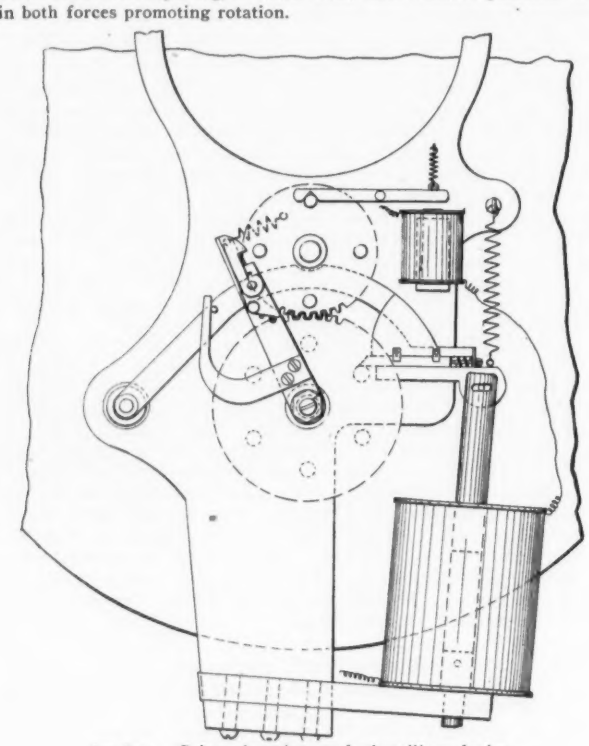
673,936. MAGAZINE GLOWER LAMP; A. J. Wurts, Pittsburg, Pa. App. filed April 25, 1900. (See Current News and Notes.)

673,951. ELECTRIC ARC LAMP; J. Herricht, Cleveland, Ohio. App. filed Dec. 26, 1900. Mechanism by which the entire lamp can be raised and lowered through an opening in a reflector to bring the arc to a central position therein.

673,952. ASYMMETRICAL ELECTRICAL CONDUCTOR; L. W. Hildburgh, New York, N. Y. App. filed Nov. 22, 1897. (See Current News and Notes.)

673,953. ASYMMETRICAL ELECTRICAL CONDUCTOR; L. W. Hildburgh, New York, N. Y. App. filed April 24, 1899. (See Current News and Notes.)

673,980. ELECTROMAGNET MOTOR; L. H. Engelhardt, Everett, Mass. App. filed June 22, 1900. The commutator is so arranged that some of the poles of the field magnet and armature will be attracting each other while others are repelling, at times when their relative positions will result in both forces promoting rotation.



673,893.—Color changing and signalling device.

674,018. ELECTRICAL CONTACT DEVICE; M. Robinson, Newton, Mass. App. filed Jan. 31, 1901. A circuit closer to be stepped on, and consisting of two plates of large dimensions separated at one end by a block of insulating material and free to be pressed together at the opposite end.

674,067. ELECTRIC ARC LAMP; W. H. Northall, Elwood, Ind. App. filed Jan. 18, 1900. The casing for the lamp mechanism is made in three parts, two of which are hinged together on a vertical axis and the third being a cap.

674,076. ELECTRIC SWITCH; Cummings C. Chesney and Herbert W. Smith, of Pittsfield, Mass. App. filed July 23, 1900. Two rods, one hinged on and located in a line considerably out of the vertical have a fuse connected between their extremities, which holds them relatively stationary. The fuse is in a receptacle surrounded by non-conducting powder. Means are provided for releasing one end of the fuse and to retract one of the terminals, thereby permitting the fuse receptacle to fall and laterally displace any arc formed. As the fuse receptacle falls the arc is displaced, both by the movement of the tube and also because the fuse is drawn through the powder contained within the receptacle.

674,097. HOLLOW TILE AND BRICK; O. C. Pixley, Chicago, Ill. App. filed Feb. 23, 1901. A conduit having an opening extending longitudinally thereof at the junction of the partition walls, and adapted to receive a dowel pin to hold the sections of the conduit together.

674,108. ELECTRIC RAILWAY SYSTEM; B. W. Tucker, Newark, N. J. App. filed Jan. 30, 1901. In order to provide for expansion and contraction the conductor is looped or bent into pockets at intervals.

674,109. ELECTRIC RAILWAY SYSTEM; B. W. Tucker, Newark, N. J. App. filed Feb. 9, 1901. The conductor lies in a trough of porcelain and is adapted to be lifted into contact with a metallic cover by a magnet carried by the car.

673,903.—Electric cable.

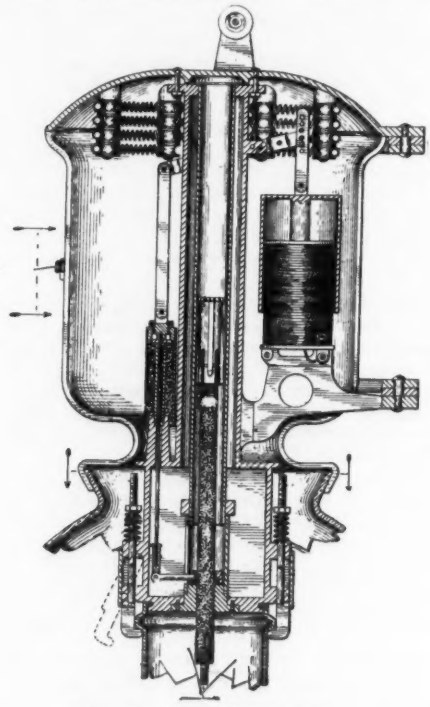
674,110. ELECTRIC RAILWAY SYSTEM; B. W. Tucker, Newark, N. J. App. filed Feb. 7, 1901. A modification of the preceding patent.

674,124. ELECTRIC HEATER; C. Robinson, Baltimore, Md. App. filed April 17, 1899. The heat is supplied by an electric arc in a closed chamber surrounded by heat insulating substances; a chamber is formed in the same structure into which to introduce the article to be heated.

674,130. ELECTRIC ARC LAMP; T. W. Young, Washington, D. C. App. filed Aug. 4, 1900. Details.

674,207. ELECTRIC SWITCH; J. C. DeJanisch, Paris, France. App. filed April 27, 1900. A double switch comprising a sliding switch member and a contact adapted to be engaged thereby, a rocking switch member fulcrumed on said sliding member, contacts adapted to be engaged by the rocking member, and means for operating the switch members.

674,280. ELECTRIC CLOCK WINDING MECHANISM; V. Odquist, Chicago, Ill. App. filed June 25, 1900. Details of a circuit closer adapted to close the circuit of the winding magnet at intervals.



674,067.—Electric arc lamp.

674,283. ELECTRIC LAMP SOCKET; J. D. Pierce, Philadelphia, Pa. App. filed May 21, 1900. The connections between the wires and the sockets are made in such a way that the lamp can be supported by the wires.

674,338. ELECTRIC ARC LAMP; J. Herricht, Cleveland, Ohio. App. filed Aug. 27, 1900. Improvements in the clutch mechanism designed to obviate the use of a dash pot.

Omitted from list issued April 30, 1901.

673,094. ELECTRICAL BILLIARD CUE CHALKER; J. E. Stoneman, New York, N. Y. App. filed Jan. 11, 1901. A piece of chalk is held in the journal of a motor; the act of placing the cue against the chalk completes the circuit of the motor and the latter in rotating chalks the cue. When the cue is removed the motor stops.

Convention of the National Electric Light Association.

THE twenty-fourth convention of the National Electric Light Association was called to order at 10.45 a. m. Tuesday, May 21, in the meeting hall of the International Hotel, of Niagara Falls, N. Y., by President James Blake Cahoon. After delivering his presidential address, which is reprinted in full elsewhere in this issue, President Cahoon called on Mr. Calvin W. Rice to read his paper entitled, "Distribution of Current at High Potential in New York City." This paper, with the ensuing discussion, is printed elsewhere.

Following the discussion, a letter was read from the manager of the French Gramme Company, announcing the death of its president, Monsieur Z. T. Gramme, which occurred Jan. 20. Resolutions were adopted expressing the deep regret of the association at the loss to electrical invention and discovery of this famous honory member of the association, whose work has done so much to promote the success of the art of modern electric lighting and the economic generation of current. A paper was then read by Mr. L. R. Wallis on the "Foresee (4-C) System of Charging," an abstract of which and the ensuing discussion will be found elsewhere.

Mr. George E. Tripp, of Boston, presented a report as chairman of the committee on uniform accounting, which will be printed in a future issue. In the discussion of the report, Mr. C. F. Hewitt, of Elkhart, Ind., expressed a wish that some means were available whereby the association could obtain from every municipality having its own electric light plant, some reliable data showing the actual costs, in order that comparison may be made between the cost of operation by municipal and private corporations. Mr. F. E. Smith, of Somerville, Mass., criticized the rules laid down by the Gas and Electric Light Commissioners of Massachusetts concerning the reporting of electric light accounts. He thinks that there would be an improvement if the data demanded were such that the companies in preparing the same could not help but know what their costs are. He believes that the great majority of central stations do not know what it is costing them per kilowatt-hour to produce their current. Mr. Charles Price, of New Bedford, Mass., said that if central station men are to make headway against the municipal movement, they must be able to show what they claim their opponents cannot show; that is, the cost of operation; when, however, he has inquired of the managers of different companies as to the cost of their product per kilowatt-hour he found that they had various opinions as to what "costs" meant, some merely giving operating expenses without any allowance for interest, fixed charges and so on. President Cahoon said that from what he understood to have been said by the Massachusetts Commissioners at the last meeting, and some that attended the meeting of the League of American Municipalities, he thinks that if the association would get up a uniform standard, the commissioners would be only too glad to adopt it. Mr. Anthony considers that an account should not be kept on a yearly but on a monthly basis, and that all bookkeeping should be absolutely kept and closed each month by itself. In reply to an inquiry as to what members were keeping monthly accounts, quite a number responded in the affirmative. Mr. R. L. Drum, of Terre Haute, Ind., advocated a form which would enable the companies to keep to themselves, if they so desire, all of the accounts which pertain to the cost of property and things of that nature, and let the association have the cost of supplying the current. Mr. Frederick Nichols said that one cannot possibly keep the correct cost of operation unless the actual cost of the capital end of the business is known. The interest on the capital is just as much the cost of trimming an arc lamp as the wages of the man who does the trimming. A rough-and-ready method of keeping the cost of operation, including the wages of employees, cleaning lamps, breakages, etc., cannot be devised. The thing must be done scientifically from start to finish.

TUESDAY AFTERNOON SESSION.

After calling the meeting to order at 2.45, President Cahoon announced that the first paper to be read would be that of Mr. Francis W. Wilcox on "The Practical Side of the Incandescent Lamp." An abstract of this paper, with the accompanying discussion, is printed elsewhere. After some announcements as to business matters and entertainment, the report of the committee on incandescent lamps, Dr. Bell, chairman, was read by Mr. James I. Ayer, member of the committee. This report is printed elsewhere with the discussion. The meeting adjourned at half-past 4 o'clock, and the delegation in a body visited the power house and plant of the Niagara Falls Power Company.

WEDNESDAY MORNING SESSION.

The meeting was called to order at 10.45 a. m. by President Cahoon.

Mr. James I. Ayer read the report of the committee on "Amendments to Freight Classification of Electrical Apparatus." A petition was presented by the committee to the railroad classification committee on Jan. 4, 1899, and a reply received that the classification committee did not deem it expedient to recommend any change in the freight classification of electrical apparatus. On April 25 notice was received that the committee would not permit oral argument before it in support of an application for change in classification. On Nov. 2, 1899, in reply to another petition, the classification committee said that it was not expedient to make any freight reduction as requested. On Jan. 22, 1900, the case was presented by the Merchants' Association of New York at a conference with the executive committee of the Trunk Line Association, and on Nov. 25 of the same year the secretary of the National Electric Light Association committee wrote the classification committee pointing out the unreasonableness of the attitude which the latter committee had taken. The letter said: "If your committee desires to reconsider their action on our previous application, and desires us orally to represent our side of the case during such reconsideration, we shall be pleased to have a proper representative take up the matter at such time and place as your committee may indicate. Beyond this we decline to take further action, as suggested in your letter, by submitting another set of demands, feeling sure that the committee's efforts can be better employed in other directions looking to the final adjustment of this matter."

In the discussion on the report, Mr. Ayer said the subject of freight classification has been in the hands of the committee for three years past, during which time a large amount of work has been done, but absolutely no tangible results obtained. The Southern Traffic Association representing the Southern railroads, had voluntarily changed the classification of electrical machinery from first class in less than carload lots, to second class; and in carload lots from third class to fifth class, putting it where it belongs in freight classification as comparing with other machinery of like character. This change took effect the first of February last. In order to make a case under the Interstate Commerce law for the courts, it was suggested to ship two castings, each weighing, say, one-half ton, one being a dynamo casting and the other an engine casting, paying the freight rate across two States. In this case one would be classified as first-class and the other as fourth class, and on that showing a case can be made to be taken to the United States Court, with the demand that under the Interstate Commerce laws a proper readjustment be made in classification. Such an obvious case can be arranged and a favorable decision would bring the classification committee to terms. This appears to be the only way to get any action having force behind it through which to obtain recognition on the part of the railroads. There is no objection to paying the same rate of freight per pound for a dynamo that is charged for an engine, but there does not seem to be any reason that the same rate of freight should be charged for a dynamo as for a barrel of glass globes or lamp chimneys, which is about 2½ times the rate per pound charged for other machinery.

Mr. Ayer said that the discrimination against electrical machinery dates back to the early history of shipment of electrical apparatus. At that time damage during shipment to electrical machinery cost the railroad companies many thousands of dollars, and as a consequence this kind of freight was put in the first class, and has never been taken out. Mr. Hoyt suggested that favorable results might be obtained by enlisting the aid of consumers, and he considers that there is not a member of the association that could not by proper looking after the matter, secure the co-operation of a local freight agent, possibly of the local general freight agent or some high official, and through the recommendation of these local officials be enabled to secure results which could not possibly be obtained through the association or through manufacturers coming before the classification committee. Mr. Ayer stated that the committee had applied to every member of the association and every central station manager in any city of 10,000 inhabitants or over, asking that they take the matter up personally, and no results had been achieved.

President Cahoon said that the matter has been thoroughly threshed out, and it is now time for action; that the matter ought either to be brought to a definite point or else dropped, since there is no use of going along from year to year dragging as this matter has dragged. A motion was then carried instructing the committee to bring the necessary suits and take whatever steps are required in their judgment to bring about the desired result.

Mr. H. W. Hillman then read a paper entitled, "Arc Lighting at the Beginning of the Twentieth Century," an abstract of which will appear in a future issue.

After the discussion of Mr. Hillman's paper the following-named gentlemen were elected as officers for the ensuing year:

PRESIDENT: Henry L. Doherty, of Denver, Colo.

VICE-PRESIDENTS: Louis A. Ferguson, of Chicago, Ill., and Charles B. Hunt, of London, Ont.

MEMBERS OF THE EXECUTIVE COMMITTEE: Mr. Charles L. Edgar, of Boston, Mass.; Mr. D. P. Robinson, of Seattle, Wash.; Mr. C. C. Howell, of Knoxville, Tenn.; Mr. E. L. Bemis, of New Orleans, La., and Mr. Dudley Farrand, of Newark, N. J.

Mr. Frederick Nichols was elected an honorary member of the association.

WEDNESDAY AFTERNOON SESSION.

After the meeting was called to order the discussion of Mr. Wallis' paper was taken up. This continuation of the discussion follows the abstract of the paper printed elsewhere. The discussion of Professor Matthews' report was next on the programme, an abstract of which follows the report printed elsewhere. The report of the committee on rules for electrical construction and operation, Captain William Brophy chairman, was then adopted. Captain Brophy also reported on the subject of the grounding of the neutral.

THURSDAY MORNING SESSION.

President Cahoon called the meeting to order at 10:30 o'clock, after which the report of the treasurer was read. This showed that the receipts for the past year were $7,776.56 and the balance in the bank at the beginning of the year $4,368.55, giving a total of $12,145.05; the disbursements were $6,143.41, leaving a balance on Jan. 1, 1901, of $6,001.64. Mr. C. R. Van Trump, of Wilmington, Del., then read his paper on "The Station Load Diagram," an abstract of which appears elsewhere.

Mr. James I. Ayer made a motion that there be incorporated in the proceedings of the Association a report of the Committee on Lighting of the Board of Legislation of Cincinnati, which contains data of much interest. This report, which has been referred to several times in our columns, is on the street lighting of St. Louis, Chicago, Milwaukee, Pittsburg, Allegheny, Edgewood Borough, Baltimore, Washington, Philadelphia, New York, Hartford and Boston, made by a committee of the city council of Cincinnati appointed to gather information concerning city lighting by gas and electricity, and its conclusions are favorable to electric lighting.

The topic selected for discussion, namely, "Steam Heating from Central Stations," was then taken up by Mr. Chas. R. Maunsell, superintendent of the Edison Electric Illuminating Company, of Topeka, Kan. In Topeka the central station now has connected 52,257 square feet of uncovered radiation, and 8,500 of covered piping, and is expecting soon to increase the radiation connected by about 50,000 feet. The conditions in Topeka are very favorable, the district covered by the pipe line including the very cream of the business obtainable. The promoters of the heating scheme said that the station could earn from $2500 to $6000 per year per 100 horse-power exhaust steam, and Mr. Maunsell said that they had managed to get a fair profit, the day load being about 250 horse-power during the fall and winter months. The steam heating is also credited with having obtained considerable of the present motor load. The pressure required on the system is from 2 to 5 pounds at the station; the greatest distance steam is supplied is 2800 feet from the station, and little difficulty has been found in giving perfect service at these pressures. The changes necessary in the station equipment were the substitution of standard steam pipe and fittings for plain exhaust piping, and the installation of a double line to enable any engine to be operated on back pressure or to the atmosphere, as the condition necessitated. The latter point is stated to be very essential to success, particularly on the peak load, for most stations will then have a surplus of exhaust. A live steam connection with reducing valve is also necessary. When the service first commenced the cost of service lines into buildings was paid, but after the first year the consumer has been more than willing to meet this expense; the consumer now pays for all the apparatus in his building except the meter, and maintains it subject to inspection.

The first year of operation the revenue received paid 55 per cent. of the coal used from October to June; the second year, 60 per cent; the third year, 72 per cent., and the year just closed 97 per cent. of the coal bill. On a revenue of $11,000 all expenses aside from coal were only $280. Experience has shown that flat rates to small customers, and meters for all large ones, is the best system. Both steam and water meters have been used, but the latter is preferred. In Mr. Maunsell's opinion 5 per cent. per annum will cover depreciation. With this system it is possible to defy competition either from isolated plants or a central station not equipped to give this service. In several cases contracts for power, light and heating were secured where parties would have undertaken to supply their own lighting plant if the whole contract could not have been taken. At present there is not a single isolated plant in the city of Topeka.

Mr. Wells, of Towanda, said that to install the exhaust heating plant in that town required an investment of $16,000. The first season, owing to a late start, the plant only earned about $1,800; the next season earnings were a little over $3,000, which paid for the extra coal and labor, and 6 per cent. on $16,000; the last three seasons the receipts from heating have been respectively $4,900, $5,100 and $5,400, which paid for every dollar of the coal bill, all extra labor, and 6 per cent. on the investment. The result of the installation of the steam plant has been that a floating debt of $6,500 has been paid off, a new 120-kw generator purchased, and many modern transformers substituted for old ones; the entire plant is now in good shape to pay dividends this summer.

Mr. Wells dwelt upon the necessity of having house steam piping large enough. The courthouse in his town is so badly piped that at times the steam pressure has to be forced to 10 pounds in order to heat the building properly. At York, Pa., there is a large plant on which the pressure does not exceed 3½ pounds of steam in zero weather. The rate charged for heating is three cents per thousand cubic feet, though a larger price is charged on a small contract and a less price where there is a large area to be heated. Since the lighting plant has no day load, live steam is used almost all the time. The cost of coal is $1.50 per ton for a poor quality of bituminous.

Mr. Maunsell said that in Topeka the city authorities required that cooling coils should be put in in order to prevent hot water from radiators passing to the sewers. The cooling coil is simply an indirect radiator with continuous circulation; that is, a radiator against which a draught of air is directed. Mr. McCabe, of Newcastle, Pa., said that steam heating in his town had not proved a success. Mr. Wells said the reason of the lack of success there was that the plant is a live steam one using small pipes, and that if it were an adjunct to a central station it would pay. Mr. Maunsell said that the proportion of fuel expense for heating was figured in the following manner: The output of the station is taken when there is no steam heating, for example, in the month of September, and the number of pounds of coal determined per kw-hour. This is taken as a basis and during the heating season all the coal in excess of the amount corresponding to this is charged to the heating system, and also the same proportion of station labor. Two dollars and twenty cents per ton is paid for slacked coal, which is claimed to possess 10,000 heat units per pound. Mr. F. N. Jewett, of Chicago, described the Alfred Lea hot water heating system. The water is heated in a surface condenser and circulated through the town at a temperature to suit the weather conditions. In mild weather its temperature is 135 to 140 degrees, and in extremely cold weather 175 to 180 degrees, in

the former case the condenser vacuum being 20 inches and in the latter 10 inches. The particular advantage of the hot water system is that the heating can be varied to suit the weather conditions, while in steam heating the temperature cannot be varied. Other advantages are that in the hot water system there is no water loss and a given amount of heating may be supplied by pipes one-half the size of those required in the steam system. Mr. Ernest Woodruff, of Atlanta, Ga., said that his company put in a steam heating plant which commenced operation last November. The experience thus far has been very satisfactory, the receipts having been $10,000 for the first season; the investment was about $100,000. Contracts have already been signed for about $8,000 worth of new business for next season. Mr. Woodruff stated that within a few years the station will be able to use every ounce of exhaust steam. Mr. Elliot, of Atlanta, the chief engineer of the plant referred to, said that in his station compound condensing engines were run in the summer time and non-condensing engines in the winter time, the steam from the latter being used for heating. The additional expense in the station to put in a steam heating system is very small, consisting principally in running a six-inch pipe the length of the station and connections for the same. The idea of regulating the temperature of the water to suit the weather conditions implies that all the buildings are supplied with radiating surface on exactly the same basis; in point of fact, the amount of radiating surface for similar conditions varies widely. Mr. Jewett said that in the hot water heating plant at Red Oak, Ia., the theory that the temperature may be regulated at the station does work out in practice. There is a schedule for the temperature at which the water ought to go out as compared with the temperature of the air, and in actual practice the water is sent out at temperatures varying from 140 to 190 degrees. The fourteen-story factory of the Western Electric Company in New York City is heated by a hot water system. Mr. Dusman, of York, Pa., said that in his city an average of 2½ to 3 pounds of back pressure is used on the steam heating, but sometimes in zero weather this is increased to 5 pounds.

The last paper of the meeting was that of Mr. Augustus Treadwell, Jr., on "Storage Batteries in Central Station Work," which was read by Mr. T. C. Martin. The discussion which followed was participated in by Messrs. E. A. Sperry, Wm. Donaldson, Chas. Blizard and R. Emory. An abstract of the paper and discussion will appear in a following issue.

There being no other business, President Cahoon made an earnest appeal to the members to take an active individual share in increasing the membership, and thanking all who had participated for their share in the work of the convention, declared the meeting adjourned.

President-Elect Henry L. Doherty.

Mr. Henry L. Doherty, president-elect of the National Electric Light Association, was born May 15, 1870, in Indiana, and reared in Columbus, Ohio. Mr. Doherty inherits his engineering bent from his father, who was a hydraulic engineer and inventor. When 12 years of age he entered the employ of Mr. Emerson McMillin, then

HENRY L. DOHERTY.

superintendent of the Columbus, Ohio, gas works, as office boy, and with the exception of a few short periods, has been continuously associated with Mr. McMillin ever since.

Mr. Doherty has made himself an authority on all questions affecting the economical equipment and operation of gas and electric plants, and much of his work has been to place on a profitable basis the numerous properties of this kind which Mr. McMillin has acquired throughout the United States. This in some cases has involved the complete modernization of equipment, and in every case the systemization of the administration and operation. He was one of the first in this country to recognize the value of a rate system, whereby consumers' charges are based not only on the current used, but also on his demand on the station capacity. A paper read at last year's meeting of the association dealt with the details of such a system which Mr. Doherty has applied with excellent results to several central stations under his supervision.

In 1896 and for several years following, Mr. Doherty was general manager of the Madison, Wis., gas and electric plants, which he brought to a high state of efficiency, and averted a threatened establishment of a municipal plant. He is now president of the Madison Company. For some months past he has been in Denver in charge of the McMillin interests in that place, but at all times he has acted as engineer and advisor to Mr. McMillin in New York.

Address of President Cahoon.

It becomes my pleasant duty, in the first year of the new century, to greet you at this historic place, now peculiarly of interest to the electrical fraternity by reason of the partial harnessing of the great Falls of Niagara, rendering them useful and subservient to the demands of man. Yet, while we know that thousands of their horse-power are being utilized, which one of us, standing by their side and listening to their mighty roar, can detect this change? They seem to hurl back defiance at the puny attempts of man to control their restless energy. What will be the answer of man at the close of the twentieth century?

We are wont to class Niagara as the greatest water-power in the world, yet it is only as the boy to the man, compared with some others. For instance, the Victoria Falls on the Zambesi River in the Dark Continent have a fall of 391 ft. and a width of 3200, while Niagara has only 177 ft. fall and a width of 1968 ft.

Long-distance transmission of electricity has become a well-established fact, and as high as 60,000 volts have been successfully transmitted, while the distance has been steadily increasing. The Snoqualmie Falls Power Company, of Seattle, Washington, recently operated a motor by means of current transmitted over a circuit 153 miles in length, the results obtained being so satisfactory as to demonstrate fully the feasibility of the plan.

In all parts of the country man is at work utilizing the water powers that nature has provided, which until the advent of electricity were in a great measure unavailable for his work. Those of our association who can recall the early days of central stations, when a few hundred horse-power were sufficient for the demand, may well feel amazed at the wonderful strides that have been made in their development during the closing years of the nineteenth century; but as the mind of man expands and develops, so will his ability to grasp higher and greater problems carry him on into those larger fields in the face of which our present works will appear even more primitive and puny than do now the central stations of the early days. As Shakespeare well says, "We must construe the times to their necessities."

In taking a retrospective glance over the past year we are struck with the fact that but little has been brought out that marks any distinct advance in apparatus. It is as though our associate members in the manufacturing field had taken the good housewife for an example, and had been cleaning here and dusting there—clearing away the cobwebs. I hardly dare say getting the "bugs" out of things, for no good housekeeper would admit that there were such things in her house; nevertheless, technical "bugs" have appeared, and must be gotten rid of before apparatus is perfected, and so, apparently, our manufacturers have been busy setting their house in order preparatory to the next great step in advance.

Turning to the field of invention, we see a few bright rays peeping forth, just enough to nourish the hope, ever latent in our breast, that some better method of illumination is to be given us. Experiments have been carried on with the Nernst lamp with a view to reducing it to a commercial basis, and we may soon look for its appearance in a practical condition for ordinary use.

Ewald Rasch, a German, has brought out an arc lamp, somewhat similar in principle to the Nernst lamp in that the carbon rods are replaced by rods of refractory material, such as the oxides of thorium, zirconium, magnesium, etc. These require heating before they will work, which is, of course, objectionable, but they possess the great ad-

vantage that the electrodes are permanent and do not require renewal. The efficiency is claimed to be about double that of the ordinary carbon arc lamps. By changing the material of the rods, the character of the light emitted may be varied.

At the Conversazione of the American Institute of Electrical Engineers, held April 12, 1901, Mr. Peter Cooper Hewitt exhibited a method of lighting by vacuum tubes in which mercury had been placed. Upon current being applied from a 115-volt circuit, the mercury was first vaporized and then the vapor heated up to a point where it emitted a light so powerful, and of such a color, as to make the light from an ordinary enclosed-arc lamp look like that given forth by a common gas jet. This is not in commercial form, as the light is very objectionable on account of its ghastly green effect, but experiments are now being carried on with other vaporized materials, and we may look for a successful issue in the very near future, for we of this day do not question the value of experiments as people did a century ago. In this connection you will all recall an incident of Franklin's career, when he replied to a man that spoke rather contemptuously in his presence of Montgolfier's balloon experiments: "Of what use is a new-born babe?"

When you visit the great Pan-American Exposition, and behold the marked advance that has been made in the arts and sciences, even since the World's Exposition at Chicago, just think for a moment that this could not have taken place except through a series of experiments taxing the brain and the patience of genius, as well as the pocketbook of capital. Both have given freely, and the world has attained a higher degree of civilization by reason thereof.

As you probably have surmised, the reason for departing from our usual custom and holding this meeting here, is that our members and friends may be able to visit the Exposition, and thus combine business with pleasure and with instruction in broader fields than our own. I particularly commend to your attention, as typical of what American citizens can do, this great Exposition. The citizens of Buffalo, out of their own resources, and by their courage, energy and grit, have created this magnificent exhibit, and they may wall and proudly say to all the world: "Come, see, we bid you a cordial welcome, and we know you will depart with a higher idea of American skill, of American pluck, and of American civilization, than you could possibly have entertained hitherto." All honor to Buffalo, and to its daring citizens, who have had the courage to bring this to pass!

In a little work entitled "The Thoughts of the Emperor Marcus Aurelius Antoninus," occurs a paragraph that struck me as applying with peculiar force to this association. Antoninus says: "We are all working together to one end—some with knowledge and design, and others without knowing what they do, as men also do when they are asleep." Largely incident to the fact that our officers are not permanent, and cannot well be so, our association has dragged along from year to year with a membership barely sufficient to carry on the routine work of the association and bear the expenses incident thereto without too frequent demands on the members for contributions to carry out some special line of work. During the past year, the matter of increasing the membership has been taken up actively, and every central station in the United States in towns of over 2000 inhabitants has had its attention called to the benefits that would accrue to it through becoming a member of this association. The result has been that new interest has been aroused in the work of the association, and a very substantial addition has been made to our membership. It has really been the inauguration of a campaign of education, and while only a beginning has been made, I feel confident that if my successors will continue the good work, material additions will be made and the association will reach the plane where it should have been long ago.

I doubt if there has been a president of this association up to the present time that has not at one time or another urged the co-operation of the members in this missionary work, and no doubt many a member has left the convention hall with the thought that he would turn over a new leaf and assist in this work, but when he has reached his home and settled down to his accustomed work, the idea has promptly fallen asleep and his good intentions have gone to naught. I cannot appeal to you in better or stronger language than have many of my predecessors. I have purposely avoided uring you unduly to aid me in this work, for the reason that past experience in similar matters showed that the result would be negative. But now that a substantial beginning has been made I feel that I can appeal to you with some degree of assurance that you will join hands with your new president and carry on the good work to a successful issue.

Our committee reports will be presented for your consideration and action. There is not one of them but has a practical bearing upon the work of this association, and I urge that you give them most careful consideration. The papers that have been prepared are by men that speak with authority on the subjects in hand, and I wish to express to the authors my appreciation of the cordial response that they have made to our demands upon their time.

Every combination of circumstances seems to be in favor of this being the best convention this association has ever held, and I hope every one present will depart at its close with the feeling that he has been well repaid for dropping his work temporarily and joining together here with others in a mutual endeavor to give and receive knowledge that will be of benefit to each and all of those interested in the work of this association.

Papers, Reports and Discussions.

MULTIPLE RATE CHARGING.

Mr. L. R. Wallis, in a paper entitled "The Foresee (4-C) System of Charging," described a method of charging for electric lighting which bears a close resemblance to the Wright maximum demand system. It is stated that the appropriateness of the title given to the system may be readily perceived "from the fact that the plan consists of a 'capacity charge' and a 'current charge,' which you will note is an alliteration consisting of 4-C's, and this may be paraphrased to mean "Foresee," indicating that the plan anticipates the commercial needs of the central station business."

The average fixed charge per 16-cp lamp is obtained by dividing the fixed charges per annum on the unit cost of the plant, by the number of 16-cp lamps per unit, this product being called the average capacity charge. It is stated that while it is perfectly consistent to expect the customer to reimburse the station for all the fixed charges that it has to meet to furnish him with the service he requires, the provision is only to insure the station against loss in carrying capacity for him, and to secure this protection it is not necessary to charge the full amount shown as being the total fixed charges, as the object is accomplished when a large proportion of the fixed charges are guaranteed. The probable fact that all of the consumers will not demand their maximum contracted capacity at the same time should be taken into consideration in establishing the capacity tariff, but not made the basis for individual concessions.

It is difficult to determine from the paper exactly what the system is or how the rates are fixed, but it appears that a variable charge per lamp is made for different capacities based upon costs of meters, cost of transformers, office expenses and meter reading, and transformer core loss. That is to say, the capacity charge for a 50-lamp installation would be less per candle-power than the cost for a 5-lamp installation. It appears also from one of the tables that a different fixed charge is made from October to June than from June to October. The above table gives the rates for a 25-lamp installation.

Hours used per day	K. W. H. used per month	Current @ 5c. Capacity charge $3.15 per month	Total charges per K. W. H. cents	Income per lamp per month	Rate per hour per lamp demanded, cents
½	18.75	$4.09	21.8	.16	1.09
1	37.5	5.03	13.4	.20	.67
2	75.	6.90	9.2	.28	.46
3	112.5	8.78	7.8	.35	.39
4	150.	10.65	7.1	.43	.355
5	187.5	12.53	6.68	.50	.334
6	225.	14.40	6.40	.58	.320
7	262.5	16.28	6.20	.65	.310
8	300.	18.15	6.05	.73	.302
9	337.5	20.03	5.93	.80	.296
10	375.	21.90	5.84	.88	.292
12	450.	25.65	5.70	1.03	.285
18	675.	36.90	5.46	1.48	.273
24	900.	48.15	5.35	1.92	.268

President Cahoon expressed the hope that the paper by Mr. Wallis would be thoroughly discussed. Several members expressed a desire to discuss the paper after they had made a study of it, and the matter was, therefore, put over to be taken up at another session.

Mr. E. Slade, of Quebec, opened the discussion Wednesday afternoon on Mr. Wallis' paper. He stated that he had put into effect in Quebec the rate system which formed the subject of a paper read by Mr. Doherty last year. Its acceptance by customers is optional, but it has taken very favorably. In Quebec there is keen competition with a rival company, and in adopting the Doherty rate the customer had to be convinced that it was to his advantage to take it. The whole hitch so far has been to get a maximum demand cut-out which will limit the demand to that contracted for. As to the fixed

charge, the first thing to be taken into account is, of course, the capitalization of the plant; this, then, is apportioned to the power service, to the incandescent and to the street lighting services. Mr. Slade considered that you cannot really take the full capitalization of the plant to establish the fixed charge per lamp. In reply to a question, Mr. Wallis said that by his system the fixed charges for incandescent lighting were based only on that portion of the plant which is used for incandescent lighting. Mr. Slade said that another point which affects the rate question is whether the station is a water-power or steam-power plant. The former can be run 24 hours a day much more economically than can a steam plant, and the transformer and meter losses do not have the same weight.

In reply to a question as to what form of maximum demand cut-out he used, Mr. Wallis replied that it is a magnetic device which is adjustable for from 1 to 25 lights. When more current is taken than has been contracted for, the device produces a flickering in the lights, which continues until the excess is turned off, when former conditions are resumed. In answer to an inquiry from Mr. Price as to how the fixed charges are established, Mr. Wallis said that an average is arrived at "by taking the fixed charges on the unit of capacity and arriving at the actual fixed charge per lamp as being the average fixed charge per lamp, and then create a maximum and minimum charge for that so that the average will strike where I find it should, and the charge of $1.25 for five-lamp capacity is plus current at 5 cents per kilowatt-hour. The Wright demand plan with which I compare my plan, carries the same first cost regardless of capacity, while it is my claim that the five lamps have to bear all of the first cost of serving a customer. It is one meter, one transformer, one customer, and the expense that attaches to the customer all the way through, so that the cost per lamp on five lamps is $3, and when we go into the larger capacity with a larger number of lamps, spread that cost over, consequently the secondary costs are reduced." In reply to a question, Mr. Wallis said that a customer's distance from the station is not considered in the rates at all. In reply to a question as to how his customers received the rate system outlined, Mr. Wallis said that at first there was some opposition, but at present he believes that customers are perfectly satisfied, having found that the system is to their advantage. He is opposed to conditional rates; the natural feeling of customers is, he said, expressed: "We are being asked enough under the old plan; we do not know where we will stand if we take another one, and they would not offer it unless it was to their advantage." In reply to a question as to how the maximum demand is fixed for one who averages, for example, an installation of 25 lamps, Mr. Wallis said that the customer selects his own demand—that is, determines the number of lamps he wishes to use simultaneously. If he finds he has selected too few he increases the demand. A device is then installed which is set for the number of lights fixed by the customer; if this is set for 10 lights he can use that number at all times, but he cannot use any more, the automatic device causing the lights to flicker when the number is exceeded. Should a customer wish a larger number for a special occasion, an arrangement is made with the central station whereby the automatic device is changed for that occasion, the charge of a dollar being made. In reply to questions Mr. Wallis said that the cost of the automatic device is $8.00 up to 25 lights, and that the capacity charge is based upon the plant capacity, and not upon the number of lights connected.

Mr. Joseph Sachs described a device, in the manufacture of which he is interested, to be used for the same purpose as that above referred to. This consists of a magazine fuse block; when the customer exceeds his demand the fuse set for that demand is blown, and there is then thrown into circuit a resistance or inductance which cuts down the number of lights.

REPORT OF COMMITTEE ON STANDARD CANDLE-POWER OF INCANDESCENT LAMPS.

During the year elapsed since its last report commercial conditions have changed in a way which has seriously impeded progress towards a uniform standardization. At the last convention, the committee brought in a proposal for methods and apparatus for standardizing lamps which was accepted, and had in preparation both specifications for standard lamp testing and a standard form of photometer which could be readily built and operated for the purpose of effecting such standardization.

During last summer, and before these specifications were completed, there appeared changes in the art which compelled the committee to stay its hand. The changes were briefly as follows, and special attention is called to them as having an important bearing on the economic use of incandescent lamps:

The committee had recommended the standard measurement in the horizontal plane made by revolving the lamp, the forms of filaments in ordinary use at the time having been such as lent themselves readily to useful and fair measurement by this particular means, which has, at all times, the recommendation of simplicity. There has developed, however, among some of the lamp manufacturers a reversion to the long, straight horseshoe filament. The distribution of light from a source having its shape is such as to exaggerate the horizontal candle-power at the expense of the luminosity in other directions.

If one takes a carbon filament of given dimensions, and by passing an electric current through it, heats it to a given temperature, the total luminous radiation emitted therefrom is substantially a fixed quantity, independent of the shape into which that filament is built. If the filament be formed into a long, straight hairpin shape, the horizontal illumination will be exaggerated at the expense of the illumination above and below the lamp.

If, as is the practice in some recent lamps, the filament instead of being so bent is twisted into a number of convolutions, the result is a large increase of the light given towards the tip of the lamp, with a corresponding decrease in the illumination given in other directions. For, since a filament of given dimensions, and at a given temperature will emit a fixed total quantity of light, other things being equal, that filament cannot be so convoluted or bent as to give a very large proportion of such radiation in any particular direction, without a corresponding decrease of the light in some other direction or directions.

The straight, hairpin filament just referred to, facilitates the production of the lamp, having an apparently high efficiency when measured in the horizontal plane. In many, a looped filament gives a correspondingly high apparent efficiency when measured off the tip of the lamp, while in point of fact the two lamps, if provided with the same filament, work at the same temperature, and work absolutely equivalent in efficiency.

Without expressing any opinion for or against any particular form of filament, the committee submits that under the commercial conditions just set forth, a horizontal measurement or a measurement in any other one particular direction, does not and cannot afford a fair basis for the measurement of the lamps having filaments of various forms, hence the committee has suspended action with regard to standard specifications for testing, pending investigation of the present commercial conditions for which it was believed that the testing facilities directed to be provided by your committee would afford a suitable opportunity.

In regard to the establishment of this standardizing bureau for incandescent lamps with which the committee was charged, negotiations were entered into with Professor F. B. Crocker and other officers of Columbia University, with reference to fitting up in that institution a laboratory for the preparation of standards, and such testing as might be desired for the National Electric Light Association. Through the courtesy of these gentlemen it became possible to utilize in a large measure the equipment which that institution already has, and the only expense which would fall upon the association was the addition of a certain amount of special apparatus for work purely of standardization. The president of the association, at the request of the committee, then laid the matter formally before President Low, of Columbia University, and obtained through him a favorable response with respect to the project.

At about the time that the matter was thus far settled, a very courteous invitation was extended by the Testing Bureau of the Edison Association to join forces with it to the extent of having the standards and other testing work of the National Electric Light Association transferred to the laboratory of the Testing Bureau. It also appeared that the National Bureau of Standardization would be probably authorized (as it since has been) by Congress just adjourned.

In this state of affairs the committee was notified by the president through the executive committee that the expenditure of some eight hundred dollars to complete the preparations at the Columbia University, might seem of dubious utility, and the matter was thus referred back to the committee.

After mature deliberation the committee is of the opinion that the National Standardization Bureau, however diligently the work of organization may be pursued, will be unlikely to be in a condition to undertake work of the kind required by the association for a considerable period of time, so that the production of standards cannot

be depended upon in the immediate future, or other work necessary to the investigation of the lamp question from other sources.

With respect to the invitation from the Testing Bureau of the Edison companies, the committee feels that while the work of this bureau will undoubtedly be carried out efficiently, it will be of positive advantage to the art to have more than one independent investigation in the matter of developing standards and the correlated questions regarding incandescent lamps which lie within the province of the association to investigate, especially as the president of the association has very earnestly charged upon the committee the consideration of the matter of candle-hours, a subject which of itself requires considerable facilities for investigation.

In the opinion of the committee the original idea of the association should be carried out, and the arrangement completed with Columbia College to do the work as originally outlined in general, subject to such changes and details as are hereinafter referred to, for the reason that in the present state of the art there is no doubt but that it is desirable to have as much investigation of the incandescent lamp from independent sources as may be possible.

A deep interest in this particular branch of electrical development at Columbia University would necessarily be developed by carrying out the committee's plan, and in the way of profitable investigation in the matter of standards of incandescent lamps, be equal to many times the sum of money involved on the part of this association in this transaction.

The committee therefore requests authority to carry out the organization of the Standardizing Bureau under the auspices of the Columbia University as herein suggested, and to incur such expense as may be necessary in the way of additional apparatus for investigations of the candle-hour problem, which were not originally contemplated in the project for the production of standards.

The committee believes that this work carried out as indicated will be very profitable to the association, and particularly in view of some impending changes in the art which may call for the investigation of new types of lamp in the near future. The estimate for this initial cost for apparatus is about $1,000, and authority is requested to expend that amount.

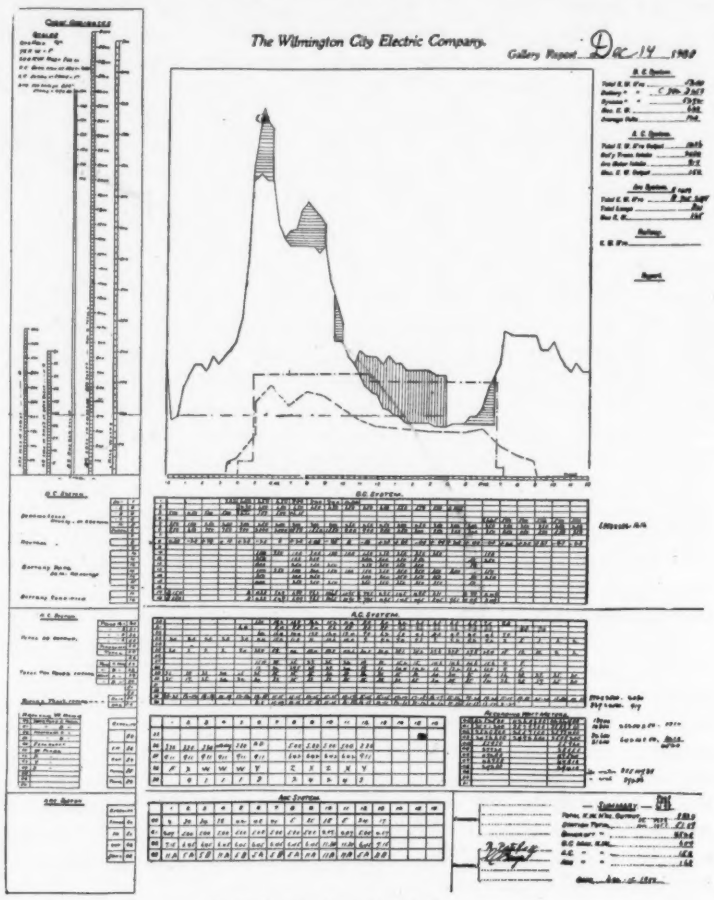
After a reading of the report, President Cahoon said that the matter before the association was, whether it wanted to spend $1,000 to equip Columbia University with additional apparatus so as to enable the association to take advantage of what apparatus they have there for the determination of lamp standards and to carry out any other tests, such as that of the Nernst lamp. Mr. Ayer said that it would be well to mention that Columbia University purposes to return to the association in yearly payments the amount of money expended for special apparatus, and to take over the ownership of the property. President Cahoon said that he did not understand that a definite arrangement had been made to this effect, but that it was suggested by Professor Crocker that Columbia University would, in the course of time, return the money by annual payments, and take over the apparatus for its own use. He said it will probably be at least two years before the National Standardization Bureau gets fully under way, so that it can meet the demands that will be made on it for testing lamps. He considered that if $1,000 were taken out of the treasury at the present time it might cripple the association, and he suggested the levying of an assessment. Mr. Converse D. Marsh asked why it should be necessary for the association to undertake technical work and go to the proposed expense when the United States Government, through the National Standardization Bureau, will soon be ready to do the work. He considered that the association could not come to any scientific determination on many of the points at issue under four or five years, the work being very delicate and technical, and requiring high skill and much time for its accomplishment. Mr. James I. Ayer thought that this objection was in fact a recommendation; the work being delicate, technical and calling for a lot of time and investigation, it follows that the larger the number of workers the better will be the results. He considered that we would be fortunate to get anything from the Government laboratory in five years, and that it is a question whether the proper men will be there to conduct the work, as politics play an important part in such institutions. He advocated the plan recommended by the committee, and said that as to money, that can be arranged for, assuming that the treasury of the association is not empty, which it really is not. Mr. Marsh said that he did not wish to oppose the committee, but that he knew the subject would take many years and many thousand dollars before it could be finished. One thousand dollars would be entirely insufficient.

A motion was finally adopted referring the matter to the executive committee, with power.

Professor C. P. Matthews referred to a method of determining the spherical candle-power of incandescent arc lamps, which involves but one reading. The method is intended to do away with determining the distribution of luminous intensity at different angles and integrating the result. Professor Matthews considers that the mean spherical candle-power is the only true measurement of the true light output of a lamp, and that the candle-power should always be expressed as mean spherical candle-power.

A STATION LOAD DIAGRAM.

In a paper with the above title Mr. C. R. Van Trump described a system which he has in use at the Wilmington, Del., central station for obtaining daily load curves of the plant. The points of the load curve are determined and plotted every 20 minutes by the switchboard attendant, and lines drawn connecting the various points. For this purpose there is a special record form, which is clamped on a board having at the left a series of ordinate scales. A ruler having on its edge divisions corresponding to 20 minutes of time is moved in parallel positions along the sheet. For a given record the ruler is moved along the ordinate scale to the position corresponding to the reading at that time. A point is then made on the record paper cor-



STATION-LOAD DIAGRAM.

responding to this ordinate and to the scale of time on the ruler. There are five separate scales of ordinates, corresponding to the total incandescent load, the total direct-current dynamo loads, the alternating load, the arc load and the storage battery output and output. The sheet also contains forms for tabulated data. A reproduction of the sheet is given in the accompanying cut, but owing to the large reduction necessary for our columns, the entries are illegible. The storage battery output is hatched horizontally and the intake vertically.

SECOND REPORT OF THE N. E. L. A. COMMITTEE ON THE PHOTOMETRIC VALUE OF ARC LAMPS.

This committee is composed of Henry L. Doherty, chairman; Professor W. E. Goldsborough and J. Q. Brown. As was the case last year the report is one of progress, the various investigations outlined by the committee not being as yet completed. The report opens with an acknowledgment of the uniform courtesy that has been shown by the various manufacturers of arc lamps and carbons in placing at the disposal of the committee the materials needed for the tests.

Practically all American makers of lamps and carbons have assisted the committee by furnishing samples of their output for test. The committee calls attention to the growing importance of the enclosed arc as an artificial illuminant, and the need of an accurate knowledge of its performance.

The tests have been carried out for the committee in the photometric laboratories of Purdue University. The committee expresses its great obligation to the authorities of the University for the use of its laboratories and equipment, and for the power facilities so essential to the conduct of the tests.

The bulk of the report deals with the life and efficiency of commercial brands of enclosed arc carbons, although the questions of steadiness of operation in lamps and the photometric values of series direct and alternating-current enclosed arcs are given some attention.

For the testing of the arc-light carbons a special photometric equipment has been designed and installed by Professor C. P. Matthews. Mr. Paul B. Sawyer has assisted him in the work through the year. Acknowledgment is also made to Messrs. Winter, Hardwicke, Le Fever, McBroom and Watjen, members of the graduating class at Purdue University, for their assistance in various parts of the work. Following is Professor Mathews' report to the committee:

Curves of the distribution of luminous intensity, such as those given in last year's report are obtained by what may be called the step-by-step method. That is to say, the mirrors are moved stepwise about the source until the complete distribution of intensity in a vertical plane has been obtained. In each position of the mirrors it is necessary to take from 15 to 25 settings in order to get a good mean. To secure these settings, to make the subsequent calculations and finally to plot and integrate the necessary curves for a single lamp require the best part of a day. Now, a test upon enclosed arc-light carbons, to be in any degree representative, must be the combined result of measurements made upon a number of samples from each brand. Such measurements should be made at intervals of 10 hours, say, throughout the life of the carbons. It becomes at once evident that to apply the stepwise method to an undertaking of this kind would be a well-night endless task. I therefore set out to develop and install an apparatus which should give at each photometer setting a value of either the mean spherical or mean hemispherical intensity, as might be desired. The difficulties encountered in the perfection of this method were frequent and oftentimes annoying. When finally the sources of error were taken care of, all the constants determined, and the method in successful operation more than half the available time for testing had elapsed. Nothwithstanding this, it is doubtful if the results could have been obtained by the slower method in time for presentation here, and one has the satisfaction of feeling that the apparatus is now in working order for expediting further work on arc-light photometry.

After certain preliminary runs to determine the efficiency of the method employed, preparations were made to test samples of five brands of carbons for enclosed-arc lighting, these brands being well-known and obtainable in the open markets of to-day. The samples represent the product of three American and two European manufacturers.

The carbons were burned in six General Electric, 110-volt, alternating-current lamps provided with opalescent inner globes and shades. Of these lamps, five were fitted with the particular brand of carbons to be tested, the sixth lamp being held in reserve lest accident or poor operation should require a substitution. Experience showed, in one or two cases, the wisdom of this precaution. The lamps were suspended from the radial arms of the wheel shown in the foregoing figure. In this position the lamps ran out the life of one trimming. With few exceptions, the only stops were at the close of the laboratory day. Counting all interruptions, the average run was about eight hours. Not infrequently, a steady run of 12 hours occurred. These conditions are probably somewhat better, and certainly no worse, than the average conditions of practice. The carbon life shown in the following results seems to corroborate this statement, as the life usually claimed for lamps of this type is 80 to 100 hours. It may be well to note just here that the duration of burning in these lamps is limited by the allowable range of descent of the upper carbon holder. This range is a fixed quantity.

A lamp fitted with a shade is, in itself, an intimation that only the downward flux of light is of value. The logical basis of comparison in such cases is the mean hemispherical intensity, or, if desired, the downward *flux* of light which is 2π the mean hemispherical intensity. In the following carbon tests, the mean hemispherical intensity is the quantity determined. In the curves it will be found plotted as an ordinate against time as an abscissa.

In what follows the brands of carbons will be designated by Roman numerals in the order of the tests, while the lamps will be referred to as *A*, *B*, etc. The upper carbon in all the tests was cored, the lower carbon solid.

Carbons I.—The results of the first test were plotted as life curves of the individual lamps in light lines, and the mean performance of the five lamps indicated in a curve derived from these. The trend of the mean curve was, in the main, upward. After 85 hours burning, these carbons show 10 per cent better performance than at the start. Lamp B distanced its companions by showing a life of 114 hours. On the third, fourth, seventh and eighth tests the points are quite close together; on the other tests, there is more or less divergence. Why this difference? The use of an apparatus for recording the changes in the arc length in lamps such as these has convinced me that these differences are due, in a large measure, to changes in the arc length. Now, the time between successive feedings is, in a well-regulated lamp, an interval considerably longer than that required for a test. During this interval between feedings, the arc tends to grow steadily longer. It has been shown by Blondel and by Ayrton that the luminous intensity of an arc at constant current is dependent in a very important way on the arc length. It seems clear then that tests such as those described here might at one time find the arcs of approximately the same length, and at another time differing considerably in length. Lack of homogeneity in either upper or lower carbon might also have an effect. It is evident that any constant difference in the carbons or in the transparency of the inner globes would be made manifest by a permanent separation of the life curves.

While the length of these curves indicates the life of the carbons and the mean ordinate their light value, these quantities alone are not a sufficient measure of the worth of the carbon. The area between the curvs and the X-axis is an important basis of comparison. This area has been found for each test. It is measured in Hefner-unit-hours. For carbons I., this quantity is 20, 200 or 202 *hekto-hefner-hours.* The mean intensity is 202 h. u. and the life on one trimming 100 hours.

Carbons II.—The mean life was practically 99 hours. However, lamp A showed the brief life of 62.5 hours. There must have been some imperfection in the fit of the gas cap on this lamp, although every precaution was taken to secure impartial treatment in this, as in every other respect. If it is justifiable to exclude A, we find a life of 107.9 hours. The Hefner-unit-hours rise in such case to 23,800 The performance of *A* indicates that the life of an enclosed arc may be seriously curtailed by causes not easily detected.

The mean curve in this test rises to a maximum at 60 hours life. Lamp F shows a somewhat remarkable performance, both as regards intensity and life. A mean intensity of 238 h. u. is maintained throughout 111 hours, or a yield of 264 hekto-hefner-hours, which is about double the yield of *A*.

Carbons III.—As regards life, these carbons show a noteworthy performance. The mean life is 115.6 hours, and the maximum life 129 hours. The mean curve does not show the tendency to rise shown in the case of carbons I., although, as a whole, it lies high. By weight the per cent, ash and dust, is about the same. An inspection of the inner globes after the tests showed that the deposit near the base of the globe in case III. was darker; that is, contained more carbon dust than in case I. This is, in my opinion, the cause of the drooping tendency to be seen in the mean curve of carbons III. after 45 hours. In this connection, it is important to note that the number of extinctions in these tests was somewhat greater than in the case of carbons I. and II. The carbon dust is due, in large part, to the pounding or chattering of the carbons at the start. These carbons show a mean performance of 252 hekto-hefner-hours.

Carbons IV.—The contour of the mean curve is smooth and represents, in an excellent manner, the life behavior of a lamp of this type. The arc appears beneath the edge of the shade at about 45 hours, giving a maximum luminous intensity at about 55 hours. The third maximum point at 100 hours was obtained in some of the other cases, and will, no doubt, always be present when the coating at the base of the globe is not too dense.

Carbons V.—The luminous intensity is low, and the life rather brief. The core of the upper carbon seemed to be of high conductivity, but of too loose structure, as it fell out in considerable quantities because of the pounding of the carbons, and collected around the base of the lower carbon. The arc was very long and well cen-

tered at the start, but not particularly luminous. The materials in the core are such as to lower the luminous intensity with little, if any, gain in steadiness of operation. The very considerable rise in the intensity curve shows that the ash on the globe was not excessive. The gain in the weights of the globes confirm this conclusion. The mean life is 85.6, the mean luminous intensity is 196, and their product 16,600.

It is of interest to plot on one sheet the mean curves of these various life histories. Fig. 1 shows the result. We may compare these five brands of carbons in three different ways, viz., on a basis of luminous intensity, on a basis of life and on a basis of intensity of life. Arranging the carbons in order of excellence, the best first, we have:

Intensity.	Life.	Intensity-life.
IV	III	IV
III	II*	III
II	IV	II
I	I*	I
V	V	V

*If *A* be included in carbons II., the starred values will be interchanged.

A partial summary of the results is given in the following table:

TABLE I.

	1	2	3	4	5
Total consumption	6.19	6.3	6.16	6.3	6.32
Consumption ratio ...	16.4%	16.5%	5.1%	8.4%	*
Clearance	.0094	.010	.0093	.0079	.0151
Extinctions	11	14	16	14	11
Average run ..	9.3	7.4	7.09	7.3	7.74
Life on one trim	100.1	98.8	115.6	105.2	85.6
Lumin. intensity	202	218	222	259	196
H. U. hours...	20,200	21,500	25,200	27,500	16,600
H. U. hours per inch	3,263	3,540	4,089	4,360	2,609

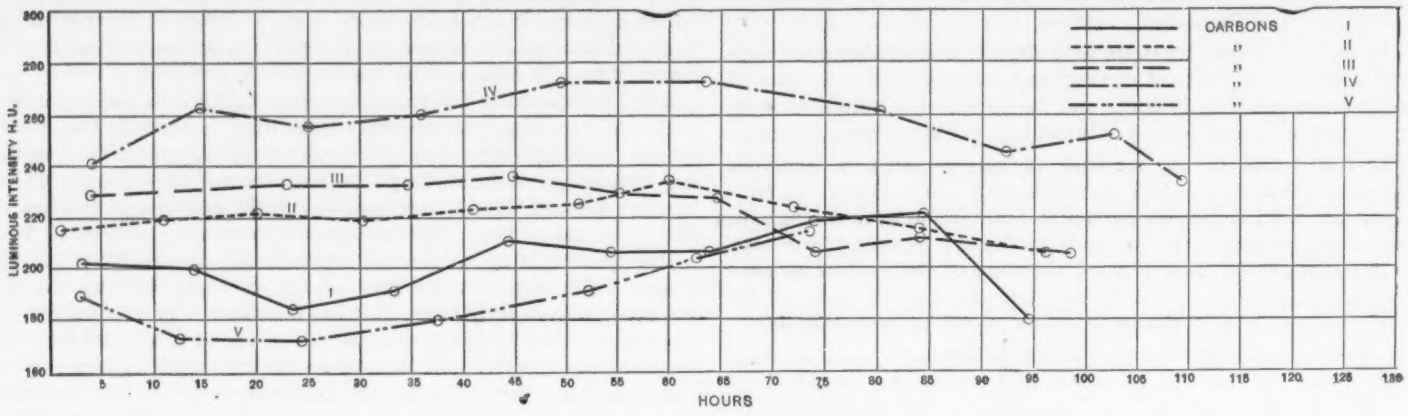


FIG. 1.—MEAN INTENSITY LIFE CURVES.

Owing to the growing importance of series-enclosed arcs, it has seemed desirable to take up their photometric value in these investigations. Fig. 2 shows the distribution of luminous intensity in the case of a direct-current series-enclosed arc, provided with opalescent inner globe and clear outer globe. The data are:

E. M. F.	70	volts.
Current	6.8	amperes
Power	476	watts.
Mean hemispherical intensity.....	329	H. U.
Mean spherical intensity.....	266	H. U.

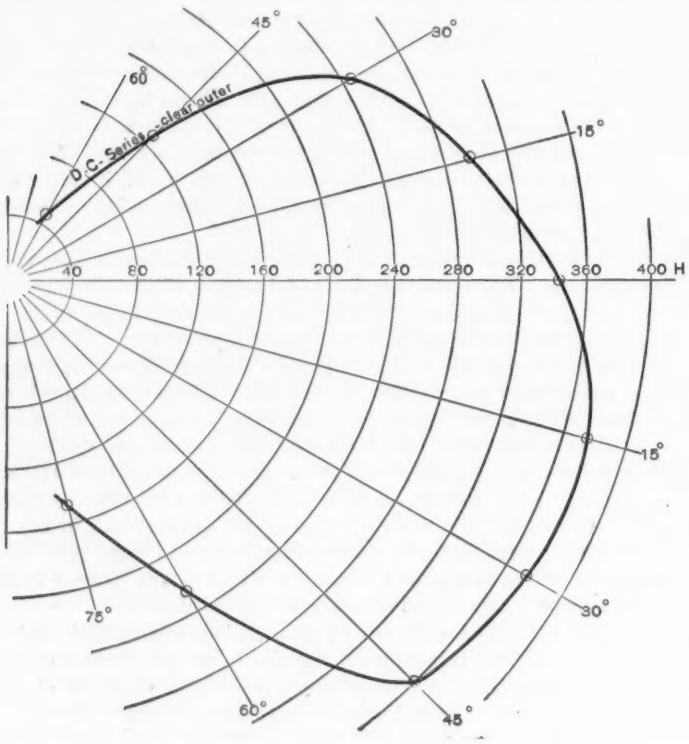


FIG. 2.—DIRECT-CURRENT ARC, OPALESCENT INNER, CLEAR OUTER.

It is of interest to note that, after 75 hours burning, carbons I., II., III. and V. gave approximately the same luminous intensity, and also that the trend of all the curves is, in the main, upward. Carbons IV. maintain a distinct lead throughout their life.

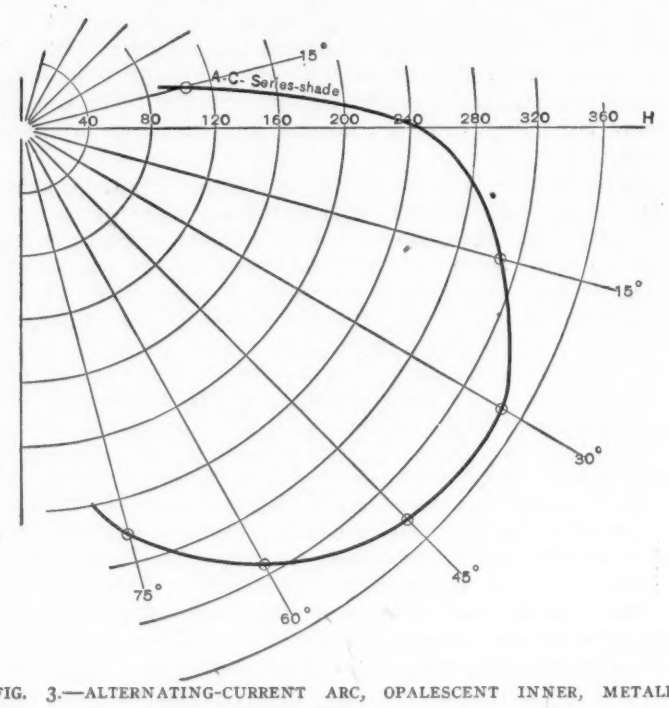


FIG. 3.—ALTERNATING-CURRENT ARC, OPALESCENT INNER, METALLIC SHADE.

Watts per mean spherical.....	1.78
Watts per mean hemispherical.....	1.45

Similarly, Fig. 3 shows the distribution of luminous intensity in the case of an alternating-current series-enclosed arc, fitted with opalescent inner globe and metallic shade. The data are:

E. M. F.	70	volts.
Current	6.6	amperes.
Power, apparent	482	watts.
Power, true	455	watts.
Power factor	.94	
Mean hemispherical intensity	314	H. U.
Watts per mean hemispher. intensity	1.44	

As tests on series arcs are still in progress, discussion of the results are reserved until further data are available.

In reply to a question as to what is a Hefner unit, Prof. Goldsborough said that it is a unit that has been adopted by the American Institute of Electrical Engineers as a better standard of light than the British candle. The ratio .88 between the Hefner unit and the British candle gives a basis of comparison. The Committee has thought it best to introduce the use of the Hefner unit in view of the standing it has received through the action of the American Institute of Electrical Engineers, and also that of the National Electric Light Association.

Prof. Matthews said that one batch of British candles will give one result and another batch an entirely different result, but with a Hefner lamp an accuracy of two per cent. can be attained. He is convinced that there is no standard quite so good as the Hefner lamp. Mr. Converse D. Marsh said that different observers at different times have found a different ratio between the two units, and he said that the Hefner lamp is variable. He believes it would be unwise for the ordinary observer to attempt to use the Hefner unit, and advises the use of an electrical standard which is as unchangeable as anything can be. Mr. Scovil, of Cleveland, made an inquiry as to what candle-power the Welsbach lamps give; Mr. Price says that he assumes that they give 50 candles. It has been said that on damp nights Welsbach lamps give less candle-power than at other times, which statement President Cahoon confirmed. Mr. W. F. White criticised the use of the hemispherical candle-power. By taking the averages of the lower atmosphere a lower average candle-power is produced and a result is thus indicated in street lighting which is not fair. In reply to a question Prof. Matthews said that from the standpoint of life, American carbons were the best, having an average of, say, 115 hours. From the standpoint of intensity, European carbons are the best. Taking the product of life and intensity—that is, candle-power hours—the European carbons give the best results.

THE PRACTICAL SIDE OF THE INCANDESCENT LAMP.

Mr. Francis W. Willcox, in the opening paragraphs of a paper with the above title, calls attention to the fact that the incandescent lamp may be greeted at the first National Electric Light Association of the twentieth century as having attained its majority, and adds that, as pointed out by Mr. John W. Howell, the lamp was practically a perfect invention, since it has to-day the same essential parts, no more and no less, and the same general appearance as when first put in service in lighting Menlo Park 21 years ago.

It is stated that the use of lamps with lower voltages than 100 is rapidly decreasing, and that it is safe to say that such lamps for central station service will be obsolete in a few years. It is recommended that in selection of a voltage the so-called standard voltage of 100, 104, 110 and 115 should be carefully avoided, and some special voltage taken, such as 107, 108, 113, 117, 122, etc. The demand for lamps of the standard voltages is many times the supply, and that producer is wise who fixes his voltage as recommended, thereby securing a close selection and protection against "culls." As to high-voltage lamps ranging from 200 to 250 volts, it is stated that over 500,000 of these are now annually supplied to customers in this country, and their use is being rapidly extended. Heretofore such lamps have been limited to low efficiency, but they can now be had of an initial efficiency of 3.4 watts per candle-power for 16 and 20-cp sizes, and with 3.1 watts per candle for higher candle-power, the lamps giving an average useful life equal to that of the 100-volt, 3.1-watt lamp —that is, between 400 and 500 hours.

The proportion of each of the several types of lamp bases now in use is given as follows: Edison, 60 per cent; Thomson-Houston, 20 per cent; Westinghouse, 15 per cent; all other types, 5 per cent. It is stated that the tendency is strongly toward a still further reduction to one base—the Edison base—which has become the standard of the world. The Thomson-Houston base costs on an average of 1 cent higher than the Edison, and it is besides objectionable by reason of the close proximity of contacts on the bottom of the base and the rending action resultant from screwing the base in too tightly. To the Westinghouse base is ascribed the objection of poor and uncertain contact. Large numbers of plants have changed from Thomson-Houston to Edison bases by the use of adapters, which cost but a few cents and pay for themselves in a year or two.

Referring to the trouble that has been experienced from the use of plaster of Paris in bases, which gathers moisture, it is said that a substitute has been in practical use for over six months, and that a moisture-proof base is now obtainable.

In the past few years there has been a large and constant increase in the use of lamps of 10, 8, 6, 4 and 2 candle-power, caused by the adoption of meters and enforced competition with gas, which is largely used turned down, and also by the general introduction of electric lighting in residences and the great increase in sign and decorative lighting. For the latter service an 8 or 4 or even 2-cp lamp served satisfactorily. The lower the candle-power, however, with the same efficiency, the more delicate becomes the filament, consequently for equal results in useful life low candle-power lamps must necessarily be of lower economy than the 16-cp lamp. As to the use of frosted lamps, it is stated that contrary to the general impression, the amount of light lost through frosting is really very small, averaging only about 3 per cent.

The subject of filaments is discussed with respect to types, and preference is expressed for a filament giving the most uniform distribution with a satisfactory minimum of tip candle-power; the filament should also be one that will not droop against the sides of the bulb, either from the weight of the filament when bent horizontally, or from other causes, and should be able to withstand vibration in the most effective manner and retain a symmetrical position in the center of the bulb. All things considered, the oval form of filament is stated to meet all these requirements most successfully, and can safely be accepted as the standard type. Such a filament is anchored, and in answer to the objections sometimes raised to anchors it can be said that for an anchor placed as it is in the standard oval filament, the advantage gained far outweighs the objections and secures results that are not otherwise possible.

A considerable portion of Mr. Willcox's paper is devoted to a discussion of lamp quality and to candle-power performance, a number of curves accompanying the latter section. One of these is here reproduced as showing the relation of volts, watts per candle-power and lighting due to different candle-powers. As an example of the use of this curve, suppose a lamp at 20 candle-power takes 114 volts, what will be its candle-power at 109 volts? One hundred and nine is 95.6 per cent of 114; 95.6 volts corresponds on the curve to 77 per cent of candle-power; 77 per cent of 20 candle-power is 14.4 candle-power. Suppose a lamp at 115 volts requires 3.25 watts per candle-power, what will be the watts per candle at 117 volts? 3.25 watts per candle corresponds to 99.8 volts; 115 is to 117 as 99.8 is to 100.51; and 100.51 volts corresponds on the curve to 3.04 watts per candle.

A considerable portion of the paper is devoted to an argument in favor of the adoption of free renewals by central stations, which we reprint below:

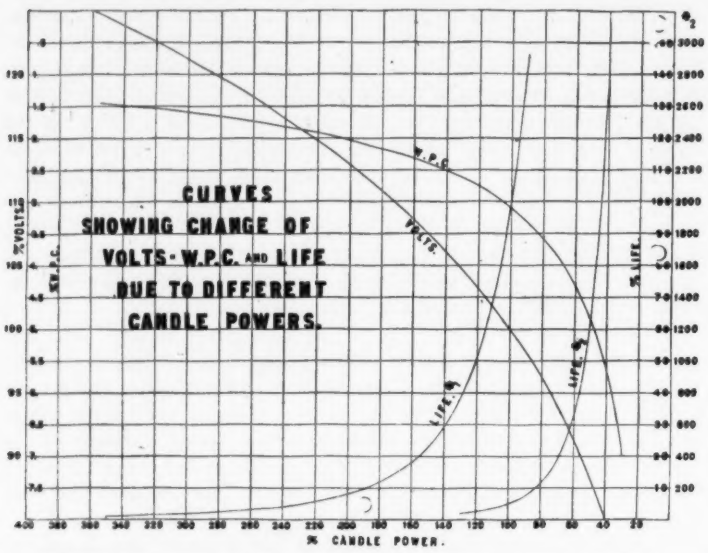
The number of incandescent lamps used to-day, although a very large quantity, is not so large as the proper and economical service of lamps demands, and the neglect of the incandescent lamps is one of the greatest drawbacks and evils from which electric lighting suffers to-day in the average central station. We find on the part of many of the large and leading central stations proper appreciation of the correct principles of lamp service and attention to the subject. They correctly consider the lamp a part of the apparatus to be owned and controlled by the lighting company, and if it were possible to get all central station managers to recognize and adopt this principle, it would effect a most marked and immediate improvement, and a signal victory for good lighting. It is difficult to understand why it is so hard to bring home to stations the true function of the incandescent lamp and the necessities of the case. The lamp is designed and used to give light, and lighting companies are in the business of making and selling light—not power. The selling is done, it is true, by the watt-hour, but what the consumer is needing, buying and using, is light. Now, it should be plainly evident that in the production of light, the lamp is practically the sole and chief essential. All the station does is to generate current; the lines deliver it; the converter transforms it; the meter measures it; but it is the lamp that produces the light. In the parlance of the day, "it is up to the lamp."

Now, if it be good practice to provide good and efficient apparatus

and lines, transformers and meters to deliver and measure current, is it not much more important to provide and care for the controlling device that produces the substances desired; that is, the light? The manager who thinks he can maintain a well-lighted service without caring for the lamps, is in the same position as the ostrich that thinks itself concealed when its head is hidden in the sand; he has forgotten the most prominent part of the system on view. The great source of trouble lies in the practice of charging customers for the incandescent lamps, and the reason for it is simply this.

Lighting results are directly dependent upon the lamp. All lamps lose in candle-power as they burn—some makes to a much greater extent than others. If lamps are not renewed, therefore, the lighting service must certainly deteriorate just as the lamp does. Extensive experience shows that few if any customers ever renew their lamps when charged therefor, except when they are burnd out. We see, therefore, that as long as the central stations charge for lamps deterioration in lighting service cannot be properly repaired.

The worst case is that where the station does not handle the lamps, and the customers are permitted to buy any and everything. This is the general practice in Europe, and it is directly responsible for the miserably poor lighting service to be found in the continental cities. Not only this, but it is responsible as well for the backward condition of lamp manufacture abroad as the only lamps there are those that cost little and have a long life; that is, cheaply made, low efficiency lamps a low-grade article. This practice, adopted from the gas business, is a most mistaken one when applied to electric lighting, as the conditions affecting the two cases are wholly dissimilar.



CURVES SHOWING CHANGES DUE TO DIFFERENT CANDLE-POWERS.

The case is somewhat better where the central station sells the lamps at a fixed price, particularly if they wisely make the price a low one. Unless, however, the price be made at cost, and preferably less than cost, the consumer is apt to buy all kinds of lamps. This plan is of value, therefore, only so far as it secures the scale of all the lamps used.

To control the type of lamp used, and thus insure the adoption of the best grade and proper efficiency of lamp, is an important essential. This is the first step, but it is only a small part of the battle. As long as the customer has to pay for the lamp, even though it be but five cents, he will generally use it through a dim and useless old age to the breaking point. He will thus always have it in his power to depreciate lighting results, and to checkmate all the endeavors of the station to improve. It seems that we cannot escape the conclusion or avoid the plain facts of the case; viz., that free lamp renewals are a necessity to the best results.

The only objection against free renewals is their cost. Let us see what this amounts to and if it be too great a price to pay for the benefit. When lamps were sold at from 40 to 50 cents apiece, the question of cost might have been a serious one, but at the present low prices we should not find it so. At present prices the cost of free-lamp renewals amounts to from one-third to two-thirds of a cent a kilowatt-hour, depending upon efficiency of lamp used. Stations can be fully reimbursed for this charge by making this increase in their meter rates, or they can advantageously adopt free renewals in place of making reductions in rates. Slightly increased rates ought to be possible for the improved service that free renewals will secure. Whether reimbursed for it or not, however, central stations can and should afford the step.

Taking average conditions, it is safe to say that free and periodic renewals will effect an improvement of 50 per cent in lighting results. Is not half a cent a kilowatt-hour a small price to pay for this? The gains secured by free renewals are:

First.—*Freedom from complaints and necessity for allowances on bills.* The manager of a big Pennsylvania station says: "We have always considered that the best advertisement was a satisfied customer, and a satisfied customer is one that is supplied with a satisfactory light, which means free and liberal renewals."

Second.—*Increased business.* With lamps charged for, the customer persists in the use of dim lamps, and the lighting service acquires a bad reputaion with the public, which does not stop to discriminate as to the cause, but condemns the service and prefers and adopts other illuminants. With the improvement rendered by free renewals, business will increase. The best solicitor and the best advertisement a station can employ is a brilliantly-lighted, well-maintained service. It will secure and hold business.

Third.—*Maintenance of rates.*—As the best goods command the best prices, so superior lighting will maintain the best rates. Electricity is admittedly a superior illuminant, and should command good rates, but the name without the service will not enable it to do so.

Fourth.—*Prevention of "outages."* Where customers buy lamps, burned-out lamps are frequently not renewed for some time, and some not at all, the result being a loss of revenue. This condition has no reason to exist with free renewals.

Fifth.—*Economy and satisfaction to consumers.*—Customers are secured the use of a high-efficiency lamp. With free renewals, the question of the life of the lamp is no factor to the consumer, whereas the cost of current is. The customer is, therefore, secured better light, and at a less cost, than is possible when he buys lamps. Customers are spared the annoyance of supplying the lamps. The customer has only to turn the switch and pay his bill; all other details the station cares for.

A large New York company states that in their efforts to keep out isolated plants they find it a distinct advantage to be able to offer a high-class efficient lamp and service to displace the poor and less efficient lamps that are usually found in isolated plants, or wherever customers purchase their own lamp renewals.

Free renewals, then, is the key to the situation, and gives the station the needed control of lamps to secure results. Now, how should this control be exercised? Shall we leave the results to take care of themselves, or shall we take full care of results and provide for the periodic replacement of lamps? It is just here that many companies fail in performance by neglecting to care for renewals. A systematic method is needed by which lamps may be periodically replaced, instead of the too prevalent custom of waiting until the customer complains or the lamps become dim, dark and disappointing. Some other standard than the limit of a customer's patience should prevail.

A good hotel does not permit its rooms to go uncleaned until the guests complain; rooms are cleaned and kept cleaned as a matter of course. This should be the principle of correct lamp service. The best method for accomplishing these results is that originated by Mr. James English, at Bridgeport and New Haven, Conn., and now adopted by many other stations in the country, at Lowell, Mass.; New Orleans, Louisiana, Atlanta, Ga., and other places. On this system employees regularly visit customers, remove all the lamps in circuit and replace them with good ones. The removing of all the lamps is desirable, as it requires no judgment to be exercised by employees, who can, therefore, be boys at a low rate of wages; it insures the certain removal of every dim lamp and a uniform replacement installation; it permits work in the daytime when a customer is not using his light.

The lamps removed are both good and bad. These are returned to the station and passed through a photometer, and can rapidly be assorted (500 to 600 an hour) into two general classes: Those above and those below any prescribed limit of candle-power taken, say 14. Those above this limit can be replaced in service at the next exchange. Those below the limit can be assorted again into classes: Those above and those below, say, 10 candle-power; the former can be used in various ways, about station, or rented for street illuminations or fetes and special occasions.

At Mr. English's station at New Haven, Conn., the residence lights are, as a rule, not disturbed; but the business sections have their lamps replaced four times during a year. Not quite one-half of

total lamps connected (representing business circuits) were removed, and over one-half by simple visual examination (passing lamps in front of a piece of white paper) were rejected. This left less than 50 per cent that merited cleaning and photometering, and nearly 90 per cent of those tested out above 15 candle-power, and worthy, therefore, of being returned to the circuit on the next exchange. The actual work, therefore, narrows down to testing but a small fraction of total number of lamps connected.

The work of cleaning is done easily and rapidly by means of a jig. A cloth, some water and a little "Boni Ami," or similar cleaner, effectually clean the globe and base with a few revolutions of the jig. Two men can work at the jig, one at each end. The work of photometering is very rapid, and, as stated above, can be done at the rate of 400 or 500 an hour. For this work at New Haven, one good man and a helper are employed. In addition, these men do a good deal of other work, including testing of all the new lamps received, some meter testing, etc. The company estimate that the work is equivalent to the full time of one man costing, say, $600 a year. On the removal and replacement of lamps, an average of 30 lamps per hour are removed and replaced, including time required in going from one customer to the next. The total cost of lamp renewals and work of renewals, etc., averages per kilowatt-hour, .428 cent, or less than half a cent per kilowatt-hour.

After the conclusion of the paper Mr. McCabe, of Bloomsburg, Pa., asked if it was a good policy to use 3.1-watt lamps by a small alternating-current station with hand regulation and transformers distributing variously in a small city; and if it would not be better to use 3.5-watt lamps and get a longer service with a regulation that is not very good. In reply, Mr. Wilcox said that the question is simply one of regulation; the limit of regulation for a 3.1-watt lamp should be, say, 2 to 3 per cent. It is possible for many alternating stations to use high economy lamps at present owing to improvements both in the station and in lamps, whereas it would have been impossible to do so in former years. He stated that it ought to be the ambition of every central station, alternating or otherwise, to improve the regulation so that they could use 3.1-watt lamps.

THE TRANSMISSION OF CURRENT AT HIGH POTENTIAL IN NEW YORK CITY.

The paper, with the above title, read by Mr. Calvin W. Rice, is reprinted below in full.

In America, the most acceptable system in cities is the low-tension Edison, 220-volt, direct-current, three-wire system. This system is the one best adapted to miscellaneous lighting, power and industrial work. The value of a power business in connection with lighting is recognized by all, and as there are in the market a score or more makes of direct-current motors, each manufacturer is therefore an agent of the light and power company.

The system requires sub-stations at frequent intervals, determined by the relative cost of transmission system loss in same and station equipment. As steam stations they have less economy than central stations, and are sometimes placed where they are somewhat objectionable to residents.

The perfection of the rotary converter has been a great factor in the ability to meet the desire to generate power in a large central station located with advantage to coal and water. With the revolving-field generator came the ability to generate current directly at high potential. It was thus rendered possible to do away with step-up transformers for all ordinary potentials and transmissions. Accompanying this advance was the development of switching and safety devices for high potentials. Thus we have in outline a perfected system, namely, the generation of current in one large station favorably located, its transmission to sub-stations, and local distribution from each such centre.

In New York, the above system is also adopted for pure power, that is, railway work, as well as for combined lighting and power. The East River side of New York has been selected for the sites of the four power stations now building. These are located at Thirty-ninth Street, New York Gas & Electric Light, Heat & Power Company; Seventy-fifth Street, Manhattan Elevated Railroad; Ninety-sixth Street, Metropolitan Street Railway, and at the northern limits of Manhattan Island, near Squyten Duyvil, for the Third Avenue Railroad station.

In all of these stations large direct-connected units are employed, generating the transmission voltage. The generators in all are of the three-phase, revolving-field type, twenty-five cycles, seventy-five revolutions. The Third Avenue station, the Metropolitan, and the New York Gas, generate at 6,600 and the Manhattan at 11,000 volts.

The transmission in each case will be in three-conductor cable laid in subways, three-inch duct in three systems, and three and one-half inch in the case of the Manhattan. In each system, also, the transmissions will be to sub-stations with step-down transformers and rotary converters. The potential of the outers of the Edison three-wire system is 270 volts nominal, and for the railway work 550 to 600 volts.

The frequency of twenty-five cycles admits of satisfactory design in the rotary converter, which is one of the essentials of the system. Low frequency is also preferable, as all the generators are direct-connected to Corliss type engines. On the other hand, it does not admit of successful lighting in either incandescent or arc, with the possible exception of the street series incandescent lighting.

The above shows the points in common to all stations. We will, however, now speak particularly of the largest station, that of the New York Gas Company. Before going to the description of the central station—which, by the way, will have the largest capacity of any in the world, and more than the completed twenty-wheel plant of the Cataract Power Company at Niagara—it is well to state that the whole system now being installed was planned several years ago.

As early as 1896, the Edison Company installed motor generators in a cellar, at the corner of Fifth Avenue and Seventy-second Street. These were 240-kw synchronous two-phase motors, direct-connected at either end to 100-kw, 135-volt Edison bi-polar generators. This was the first step in New York City in the development of the present sub-station employing rotary converters.

In 1898, two-phase, 200-kw rotary converters were installed in the Eighty-third street station, and later, in that same year, three-phase rotary converters were placed in the Duane Street and Thirty-ninth street stations, so that energy could be transferred at 6600 volts alternating between the districts.

The efficiency when transmitting 1000 kilowatts, the full load of a rotary, from the direct-current switchboard at one generating station, including all transformers and line loss, to the direct-current switchboard at the receiving station, is eighty-one per cent. This shows the practical economy of a flexible system.

By this means the Duane street station, which is situated at the southerly end of the island, can follow the load as it moves uptown with the people as they go from business to their homes, and then to the stores and theatres. A very high load factor is thus obtained throughout the year.

The waterside station occupies the block between Thirty-eighth and Thirty-ninth Streets on First Avenue down to the East River. It is situated at nearly the geographical centre of distribution. The area covered measures 272 feet by 197 feet, so that with its ultimate capacity of 125,000 horse-power they will have a horse-power for every 0.43 square foot, and in this respect will have not only the largest station, but also the most economical of space.

The equipment will be sixteen direct-connected units. The engines will be 5,200 horse-power at most economical cut-off, and will have a maximum capacity of 8,000 horse-power. They will be vertical, three-cylinder, compound-condensing, taking steam at from 175 to 200 pounds.

The generators will be 3500 to 4500 kilowatts at 6000 volts, and will have a regulation of eight per cent., and on short circuit will give about three times full-load current. These characteristics of regulation and high self-induction insure smooth running and good synchronizing ability.

Steam will be supplied from fifty-six water-tube boilers, 650-hp each. Each boiler will be equipped with mechanical stokers. The boilers will occupy two floors of the boiler house; the coal bunker, with a storage capacity of approximately 10,000 tons, being located immediately above the boilers. There will be four steel stacks, about 200 feet high and nineteen feet internal diameter. These will be supplemented by fan blowers for forced draught.

Condensing water for the engines will be supplied from East River through a main exterior intake tunnel ten feet in diameter. This tunnel will be divided at the building line into two eight-foot tunnels, which will run under the two rows of engines. The discharge tunnel will be placed just above the intake tunnel.

The switchboard will be distributed in galleries. Single conductor cables will be led out from ducts in the foundations of the

generators and will go to electrically-operated oil switches situated on the first gallery. From there cables will go to the selector air switches on the top gallery. These selector switches will be operated by hand and are to be used as a safety in an emergency when the oil switch fails to act.

As there will be sixteen units, so there will be sixteen banks of oil switches. In between each group of three oil switches, one for each phase, will be the transformers for the instruments, voltmeters and ammeters.

On the top gallery the grouping of the switchboards will be such that it will be physically possible for one man to control the entire situation. Of course, two men will be on duty at all times, as a matter of practical operation, but it is interesting to note that the switches will be so grouped with their instruments that one man can handle the situation.

The governing control of each engine will be manipulated also from this point, and one will be able to vary the cut-off from twenty per cent. to forty-five per cent., or the speed two and a half per cent. each way from normal.

The cables for the transmission are lead-covered, three-conductor, 250,000 circular mils. At first only rubber was used, but this last season paper was tried, so that now it is about equally divided, there being about twenty-five miles of each.

In the rubber cable each conductor is insulated with six-thirty-seconds of an inch rubber insulating wall. The three conductors are then laid with jute and made into a cable of circular section and another jacket of rubber put on, four thirty-seconds of an inch in thickness. The rubber compound is thirty per cent. pure Para. The lead is one-eighth inch thick, three per cent. tin, but with no outside coating of tin. This gives a cable two and five-eighth inches outside diameter, and the experience from laying fifty miles of cable would indicate that this is the largest practical cable that can be installed in a commercial three-inch duct.

The insulation resistance required on the rubber cable was 1000 megohms per mile, measured either between conductors or between conductor and lead. The completed cable was tested to 20,000 volts in the ducts.

The paper cable was similar, but with two thirty-seconds inch more insulation in the outer jacket, making twelve thirty-seconds inch insulating wall in all directions. Insulation resistance required on this was 400 megohms per mile.

The paper cable measured two and eleven-sixteenths inches outside diameter, and although it has all been installed, yet it was done with difficulty; and one would not advise attempting it again, as it was a great mechanical strain on the cable. The natural question in the minds of many is, which is better? It is proper to say that satisfaction has been obtained with both.

The number of conductors at present installed is such that at no point in the system is there more than five per cent. actual drop in any feeder. As 40,000 feet is the longest, it happens that the five per cent. limit on drop at that distance is reached at the maximum ampere capacity of the cable, which is about 225 amperes, or a little over 2250-kw. This gives a little over two watts per duct foot, which is also a limit in subway work. Were there a larger number of ducts in one trench, even two watts per duct foot could not be allowed.

Cables are allowed sufficient slack to be carefully racked on the sides of the manholes. The outside of the cables is wrapped with asbestos and steel tape, so that in the event of one cable failing it will not melt the lead and insulation off its neighboring cables. This covering, complete, costs about five dollars per cable per manhole.

At the sub-stations the cables go to marble switchboards, each circuit is provided with safety devices. The switchboard cables lead to the air-blast transformers, which are connected in to give a double delta or six-phase relation on the secondary.

The rotaries are six-phase, as it is agreed that their action is better, less armature heating, and the amperage led into each collector ring is reduced. Between the statics and the rotary are the induction regulators. These regulators have about thirteen per cent. of the capacity of the rotary, as a potential regulation of thirty volts is required either way of normal, which is 270. Only two sizes of rotaries are used, 500 kilowatt and 1000 kilowatt.

An interesting feature of the entire system is that all translating devices are in multiple; that is, all rotaries, in whatever location, are in multiple on the alternating-current side with the generators at the central station and with every other rotary in the sub-station. On the direct-current side every rotary is in multiple with every other rotary, direct-current generator or storage battery. By means of the field rheostat all rotaries are operated at minimum input, which gives a power factor of one to the system.

Floating on the system in almost all of the rotary and sub-stations are storage batteries. The most common unit is one of 150 cells, having a capacity of 2000 amperes discharge for one hour.

The completeness of the system is shown by the uniformity of potential and continuity of service. It is considerably over ten years since there has been an interruption of service.

Upon concluding the reading of his paper, Mr. Rice was asked by Mr. Frederic Nicholls, of Toronto, how long the rotary converter system and the six-phase rotaries have been in service, and to what extent they have been loaded up, and how long they have been loaded up to the full-load capacity. In reply, Mr. Rice said that the beginning of the use of the rotary converter system in New York dates from 1898. At the outset the rotaries were not operated continuously throughout the day, but used as a convenience and not as an essential to the system. He could not give the exact date when the rotaries became essential to the system, but it was probably about 1899. The first rotaries, and even those installed last fall, were run very often at 50 per cent overload, for the reason that the manufacturers could not make deliveries as fast as the demands came upon the system. Often upon notification of the shipment of a rotary from the factory, teams would be ready to take it the minute it reached the city, and it was not unusual to install a 1000-kw rotary and have current on it in 30 hours, and load it up immediately to 50 per cent overload and continue its use every night on the peak.

ATTENDANCE LIST.

The names of those in attendance representing central stations are given below. Other names of the manufacturing and supply trade, visitors, press, etc., will be found duly recorded elsewhere.

Chicago Edison Company.—S. Insull, W. M. Anthony, R. C. P. Holmes.
Cleveland, Ohio, Electrical Illuminating Company.—S. C. D. Johns, S. Scovil, M. E. Turner, G. B. Tripp.
Birmingham, Ala., Consolidated Electric Company.—J. M. Bradley.
Cincinnati Edison Company.—W. F. White.
Pawtucket Electric Company.—H. A. Pierce, Orrin Smith, Jr.
Jacques Cartier Water Power Company, Quebec.—E. Slade.
New Omaha, Neb., Thomson-Houston Company.—W. J. McManigal.
Bristol, Pa., Electric Light & Power Company.—C. E. Scott.
Ottawa, Canada, Electric Company.—John Murphy.
Montreal Lachine Rapids Company.—R. S. Kelsch.
New Bedford, Mass., Gas & Edison Company.—C. R. Price, D. W. Beaman.
New York Edison Company.—C. W. Rice, E. A. Leslie.
Louisville, Ky., Electric Light Company.—G. W. Hubley.
Derby, Conn., Gas Company.—R. E. Wyant.
Bellows Falls, Fall Mountain Electric Light Company.—H. Bottomley.
Westchester Lighting Company, Mount Vernon, N. Y.—J. E. Hodgson.
Fulton County Gas & Electric Company.—C. M. Allen, Gloversville, N. Y.
Toledo, Ohio, Consolidated Electric Company.—E. J. Bechtel.
Lorain, Ohio, Gas Company.—C. A. Schwarm, A. B. Walton.
Lowell, Mass., Electric Light Corporation.—H. T. Edgar, H. A. Wright.
Brockton, Mass., Edison Illuminating Company.—A. W. Leonard.
Somerville, Mass., Electric Light Company.—F. E. Smith.
United Electric Company, of New Jersey.—W. W. Titzell.
Philadelphia, Pa., Brush Electric Company.—A. H. Manwaring.
Bridgeton, N. J., Electric Company.—B. F. Hires.
Woburn, Mass., Light, Heat & Power Company.—L. R. Wallis.
Newton, Mass., and Watertown Gas Company.—W. A. Learned.
Bradford, Conn., Lighting & Power Company.—F. H. Golding.
Westmoreland Electric Company.—Greensburg, Pa.—W. R. Kenney, E. H. Barr.
Johnstown, Pa., Electric Light Company.—A. Weis.
Irwin Electric Light & Power Company., Greensburg, Pa.—W. S. Lane.
Southbridge, Mass., Gas & Electric Company.—A. F. Hall.
Elkhart, Ind., Electric Company.—C. F. Hewitt.
Nashua, N. H., Light, Heat & Power Company.—G. L. Sadler.
Georgia Electric Light Company, Atlanta.—J. G. Rossman.
The Erie Company, Erie, Pa.—M. J. Fogarty.

Savannah, Ga., Edison Company.—G. E. Tripp.
New Castle, Pa., Electric Company.—J. M. Walker, G. Thompson.
Peninsular Electric Light Company, Detroit, Mich.—E. F. Phillips.
Meriden, Conn., Electric Light Company.—H. Minkwitz.
Capital Electric Light, Motor & Gas Company, Boise, Idaho.—F. R. Kerr.
Walla Walla, Wash., Gas & Electric Company.—E. C. Morrow.
Imperial Electric Light & Power Company, St. Louis.—H. A. Lardner, S. B. Way.
Atlanta, Ga., Railway & Power Company—E. Woodruff, T. Elliott.
West Chester, Pa., Edison Company.—J. E. Pyle, H. C. Baldwin.
Boston, Mass., Edison Company.—C. L. Edgar, H. A. Wagner, W. Brophy.
Schenectady, N. Y., Illuminating Company.—J. R. Lovejoy.
B. & O. Railroad Plant, Baltimore.—W. D. McDonald.
Sioux City, Iowa, Electric Company.—C. C. Gartland.
Excelsior Electric Company, Port Huron, Mich.—J. E. Davidson.
Topeka, Kans., Edison Illuminating Company.—C. R. Maunsell, J. P. Griswold.
Seattle, Wash., Electric Company.—D. P. Robinson.
American Electric Light Company, Bloomsburg, Pa.—E. F. McCabe.
Carlisle, Pa., Gas & Water Company.—C. E. Ramsey, J. M. Crider.
Worcester, Mass., Electric Light Company.—H. H. Fairbanks, W. H. Coughlin.
London, Ont., Electric Company.—C. B. Hunt.
Cumberland Electric Light & Power Company, Nashville, Tenn.—R. Emory.
Marlboro, Mass., Electric Company.—F. O. Barnes.
Elmira Light & Railroad Company, N. Y.—A. E. Walden.
Ashtabula, Ohio, Lighting Plant.—E. E. Beam.
Rochester, N. Y., Gas & Electric Company.—G. A. Redman.
Hartford, Conn., Electric Light Company.—R. W. Rollins.
Stamford, Conn., Gas & Electric Company.—R. Crawford.
Norfolk, Va., Railway & Light Company.—P. Wright.
Towanda, Pa., Electric Illuminating Company.—C. P. Wells.
York, Pa., Edison Company.—J. F. Dusman.
Lancaster, Pa., Electric Light, Heat & Power Company.—E. D. Ruth.
Lancaster, Pa., Edison Company.—C. E. Titzell.
Dundee, N. Y., Electric Light Plant.—E. L. Bailey.
Niagara, St. Catherines & Toronto Railway Company, St. Catherines, Ont.—E. F. Seixas.
Buffalo, N. Y., General Electric Company.—C. R. Huntley, G. Urban, Jr.
Catania, Italy, Street Railway Company.—Cesare Pio.
Galion, Ohio, Electric Light Company.—H. C. Dye.
Augusta, Ga., Railway & Electric Company.—W. E. Moore.
Springfield, Ohio, Light & Power Company.—J. H. Miller.
Franklin, Pa., Electric Company.—B. F. Ott.

CONVENTION NOTES.

The convention was in many respects one of the best—large but not the largest; with not many exhibits, but a whole exposition under its lee; several good papers and a steady run of sober, useful discussion. There was a marked infusion of new blood, and the men there for the first time were not long in getting their orientation. If they lacked anything, their good friends, the supply men, were at every elbow. In the discussions, a notable number of central station men took part, as in that on steam heating; and on more than one occasion, the discussion might well have been prolonged. A great many members went over to the Pan-American to study the lighting effects, and the remarkable display of Nernst lamps by the Westinghouse Company in Electricity Building was a universal theme of comment. Mr. Cahoon was congratulated at the close on a very successful year of office, and his expressed desire to see the membership of active lighting companies far more than the present 10 per cent. of the possible was heartily echoed.

VISITORS to the Convention not mentioned elsewhere included Dr. E. L. Nichols, of Cornell University; Prof. W. E. Goldsborough, of Purdue University; B. B. Hatch, of the Boston Public Buildings Department; Harold Almert, Lincoln Park Commission, of Chicago; H. H. Humphrey, E. E., St. Louis; H. W. Young and E. Bergtheil, of London, England. T. R. Mercein, secretary Northwestern Electrical Association, of Milwaukee; Prof. C. P. Matthews, of Purdue University; E. A. Deeds, engineer of the Natural Food Company, of Niagara Falls; G. M. Hoag, city electrician, Cleveland, O.; H. W. Buck and P. M. Lincoln, of the Niagara Power Company.

ELECTRICAL WORLD AND ENGINEER was represented by President J. M. Wakeman, Messrs. J. V. S. Church, G. W. Elliott and E. T. Walker, of the business department, and Messrs. T. C. Martin and J. R. Cravath, of the editorial staff.

LADIES PRESENT.—Rarely has an N. E. L. A. convention had so many ladies present. The list includes Mesdames S. C. D. Johns, Mabelle Johns, S. Scovil, S. Insull, W. F. White, A. T. Clark, J. M. Hill, J. M. Wakeman, W. K. Beard, C. P. Poole, E. E. Wood, A. E. Clifford, J. L. Wilson, E. L. Decker, F. L. Perry, W. A. Kreidler, C. E. Scott, Helen Scott, T. C. Martin, R. E. Wyant, C. F. Munder, P. S. Tilden, J. W. Godfrey, Pearl Godfrey, W. M. Anthony, J. D. Meister, W. M. Deming, J. R. Baldwin, H. L. Baker, C. W. Baker, J. P. Coghlin, R. Emory, E. A. Leslie, Miss Leslie, W. C. Hubbard, S. M. Young, E. Woodruff, E. W. S. Gray, A. J. Wurts, F. H. Taylor and others whose names were not registered. On Wednesday evening a hop was given at the International, followed by a cakewalk, in which Miss Barnard greatly distinguished herself, her beauty being enhanced by a most graceful carriage in that difficult form of calisthenics.

THE ELECTRICAL PRESS was in unusual strength. Beyond the staff of this journal there were also present Messrs. W. T. Hunt, C. W. Price, C. T. Child, W. A. Kreidler, F. L. Perry, S. Goddard, C. P. Poole, W. K. Beard, A. E. Clifford, E. E. Wood, W. E. Keily, F. S. Kenfield, T. E. Crossman, E. B. Biggar, J. D. Meister, J. D. Downer.

MR. E. F. SEIXAS, an old-time electrical man in this country, though still in his teens from appearances, has been made manager of the Niagara, St. Catherines & Toronto Railway Company. He did a very graceful thing Thursday in taking off a party of ladies and gentlemen, fifteen in number, on a trip over his road to St. Catherines and then down to Port Dalhousie. The party then returned to lunch at St. Catherines and reached the Falls about 2:30 P. M., having spent a most delightful morning.

MR. C. R. HUNTLEY, general manager of the Buffalo General Electric Company, one of the earliest and best presidents of the association, was constant in attendance, as soon as released from duties caused by his prominence in the Pan-American directorate. Generous hospitality was extended at his rooms, and on Wednesday evening he gave an informal but delightful banquet in the Ladies' Ordinary to a score of "Old Timers." Several who would have liked to be present were away at the Show, but the roster included Messrs. Huntley, Habirshaw, C. O. Baker, Corey, Shippy, Bailey, Porter, McQuaide, Urban, Garrison, D. Rankine, McLean, Brophy, Page, H. B. Kirkland, C. Holmes, A. Patterson, E. A. Leslie. There were many toasts to the pioneers and to the newer men, and the evening was one unbroken succession of fun and reminiscence, with just the touch of pathos coming from the remembrance of the days that are no more.

THE GORGE ROUTE is one of the most spectacular trolley rides in America, and for its close touch to peril may be compared with some of the Swiss electric rack roads like that skirting the Jungfrau. Of late one of the attractions of the Gorge has been the illumination of it by special searchlight, and on Tuesday evening, by invitation of Manager Morgan, on behalf of the trolley company, the convention went en masse down the Gorge to see the searchlight play on the gigantic breakers and their clouds of spray. The evening was clear, with a young moon hanging over the Gorge, and the spectacle was declared thrilling beyond imagination. The searchlight has now been reinforced by some 40 enclosed arcs, grouped in pairs in front of reflectors so that a steady white light can at all times be thrown on the rushing torrent.

MR. C. O. BAKER, JR., master of transportation, while he had not been called upon this time to furnish a special train from New York, was present as usual, and discharged his voluntary duties as a perambulating information bureau with wonted courtesy and infallibility. On Tuesday he did secure a special for a convention trip to the Pan-American, but it rained so heavily that the excursion had to be reluctantly abandoned, much to his disgust.

MR. FREDERIC NICHOLLS, the mainspring of the Canadian General Electric Company, was heartily welcomed by a host of American friends, many of whom wanted details of his recent big lighting consolidations and the extension of his manufacturing interests. His power transmission enterprises for the benefit of Toronto are likely soon to make a stir in the great world of engineering and finance.

MR. LUTHER STIERINGER, the consulting electrical engineer of the Exhibition, was kind enough to go down nightly from Niagara as a personal escort and cicerone, to explain the features of the superb

lighting effects, especially those of the Howard Tower, which he has made a veritable gateway to the Celestial City itself.

EX-PRESIDENTS were plenty, the list including Messrs. Huntley, Nicholls, Insull and Ayer, to whom Mr. Cahoon was added, as he lay down the gavel at the close of the convention. The new president, Mr. Doherty, is also an ex of the Northwestern Electrical Association. It was much regretted that he was unable to be present, but another year of brisk administration is very confidently expected by all his friends.

THE NIAGARA POWER COMPANY received the convention at their splendid power house on Wednesday afternoon, Messrs. Rankine, Buck, Lincoln and others taking a part in exhibiting the apparatus to the visitors. As a new power house is now building on the other side of the canal, facing the old one, the plant could virtually be seen in every stage of construction and operation. The new 20,000-volt circuit to Buffalo has just been thrown on, so that was in evidence also, and its manipulation attraced much attention. Some of the members also took in the big Schoelkopf plant down the Gorge.

MR. F. E. BARKER, of the Massachusetts Gas & Electric Light Commission, was a familiar and welcome figure. The work of the commission came up two or three times in the discussions.

MR. CESARE PIO, of the Catania (Italy) Street Railway Company, was quite interested in convention methods and in the Niagara power utilization.

EXHIBIT NOTES.

THE EXHIBITS this year were very few and far between. It is said that, on the contrary, never before were so many manufacturing concerns represented by their officers, salesmen, etc. In spite of consolidations in various lines the expansive tendency of electricity was never more marked than at present, and the new faces, new lines and new ideas challenging attention and acquaintance were frequently commented on by the Old Timers, who again were far more numerous than of late years. One of the reasons for the few exhibits was the fact that only a few miles away at Buffalo was the show with an Electricity Building and a great variety of electrical exhibits, specialties and attractions. Thither all steps tended, somewhat to the dividing up of the convention, but quite naturally, and giving a unique flavor of interest and novelty to the occasion. As one of the newly married members put it, he had four attractions all going at once—his wife, the Falls, the convention and the show, and he now knew what distraction meant. A series of running notes below mentions those seen in attendance, and if in the hurry one or two names have been overlooked the compiler tenders his apologies in advance. There are easier jobs than taking such a census.

H. W. JOHNS MANUFACTURING COMPANY, of Hartford, was represented by Mr. Joseph Sachs, who had an excellent compact exhibit of his Noark switches in the hall, and was most busily occupied in discussing its merits and peculiarities. Mr. A. H. Berry, of the concern, was also there.

MR. G. F. PORTER, the busy secretary, was, of course, spokesman also for the Brixey Kerite Cables. He went direct from the convention to Seattle, bound for Alaska, where he is laying Brixey cables for the Government while the thaw is on. Miss Billings, his assistant secretary, was, as ever, efficient, indefatigable, intelligent, omniscent and sweet-tempered in every emergency.

THE EDISON STORAGE BATTERY was a theme of discussion, and a few advance copies of the Institute paper on it were eagerly snapped up by those lucky enough to get them. The consensus of opinion appeared to be favorable, with the customary phrase, "Time will show."

PHOENIX GLASS COMPANY was represented by Mr. Alec. Patterson, who has attended so many conventions one's memory hardly runs to the contrary. The development of electricity has brought many corresponding growths in fine glass work as shown in the Phoenix productions.

E. F. PHILLIPS ELECTRICAL WORKS, of Montreal, Canada, were represented by G. H. Olney, 2d.

STANDARD CHEMICAL COMPANY, of Boston, was represented by Mr. G. B. Davis.

MR. H. G. LANDIS came all the way from Wichita, Kan., for the Electric Supply & Construction Company of that city.

CHASE-SHAWMUT COMPANY, of Boston, and all their fuses, etc., were represented by Mr. A. P. Moore.

E. B. LATHAM COMPANY, of New York, was vouched for by Mr. R. L. Caldwell.

WESTERN ELECTRIC COMPANY had in attendance P. M. Fletcher and E. W. Rockafellow.

CHAS. A. SCHIEREN COMPANY, of New York, was suggested in connection with belts by Mr. A. W. Harvey.

BOSSERT ELECTRICAL CONSTRUCTION COMPANY, of Utica, N. Y., were represented by Mr. F. G. Scofield, who soon learned that many of the delegates visiting the Pan-American had seen and greatly admired their magnificent switchboard and instrument exhibit in Electricity Building.

MR. J. L. HINDS, of Syracuse, N. Y., had many an excellent opportunity, promptly availed of, for discussing the work of his company.

JOHN A. ROEBLING'S SONS COMPANY was ably represented by Messrs. H. L. Shippy, G. C. Bailey, F. W. Harrington, H. C. De Camp, G. W. Swan, M. P. Bowman and D. F. Irvins.

CANADIAN GENERAL ELECTRIC COMPANY, which is branching out into very heavy general engineering, was represented by Mr. H. G. Nicholls, "a chip of the old block," who is taking a very active and responsible share in the management of that large and progressive concern, the second or third largest electrical manufacturing company under the English flag, and right abreast of anything American. Mr. E. D. McCormack was with him.

OKONITE COMPANY, of New York, was represented by Mr. George T. Manson.

DR. W. M. HABRISHAW and J. W. Godfrey were present in behalf of the India Rubber & Gutta Percha Insulating Company.

AMERICAN CIRCULAR LOOM COMPANY was represented by Messrs. A. T. Clark, R. B. Corey, T. G. Grier, J. L. Wilson and E. L. Decker.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburg, was represented by the following: Pittsburg—H. P. Davis, H. C. Ebert, J. S. Peck, W. M. Probasco, F. H. Taylor, E. M. Tingley, A. J. Wurts, C. F. Scott. New York—E. W. S. Gray, F. B. H. Paine, Calvert Townley. Boston—W. F. Fowler, D. E. Manson, R. L. Warner. Syracuse—Paul T. Brady. Cleveland—N. S. Braden. Detroit—W. C. Armstrong, C. F. Medbury. Buffalo—E. A. Eames, T. C. Frenyear, C. W. Underwood. Niagara Falls—L. E. Imlay. The company had parlors on the first floor, but had no need to make an exhibit, Niagara Falls being full of some of its finest work At the Pan-American Exposition, the delegates were especially interested in the lighting of the interior of the dome of Electricity Building. Under a canopy of light green and lavender draperies, against which the white bulbs shine beautifully, are suspended in festoons 98 Westinghouse-Nernst self-igniting lamps, all of 400-cp each. Where the festoons of lamps converge at the top of the dome hangs a large central Nernst of 2000 candle-power. In each of the 400 lamps are six glowers, which individually are good for 50 candle-power, and in the large central lamp there are no fewer than 30 glowers bunched. At present this striking exhibit is dependent on outside circuits, but it will soon be fed by a fine Westinghouse direct-connected gas engine unit, the engine being supplied with Buffalo natural gas.

SPRAGUE ELECTRIC COMPANY was represented by Mr. Alex. Henderson, in charge of its interior conduit interests, and Mr. H. G. Issertel, who represented its dynamos and motors, this being by no means his first convention, but his first in the company's interests. Both gentlemen were active and efficient in their duties.

GENERAL C. H. BARNEY had no trouble in finding ready ears to entertain his account of the virtues of the Monarch Fire Appliance Company's extinction apparatus.

S. B. CONDIT, JR., of Boston, represented the firm bearing his name. There were many inquiries about the interesting new double frontboard he has just built for the big new power transmission work of the central station company at Manchester, N. H.

THE ELECTRICAL MATERIAL COMPANY, of Baltimore, was represented by Mr. Arthur L. Bosley.

MR. JAMES WOLFF, western manager for the New York Insulated Wire Company, was on hand furthering his company's interests at convention, with P. H. Hover.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, was well represented in the person of Frank G. Bolles, who distributed a handsome Bullock Pan-American chain medal charm.

MR. T. H. LANE, of the Warren Electric Specialty Company, of Warren, Ohio, was in attendance. Mr. Elmer W. Gillmer, secretary and treasurer, was also active throughout the convention.

THE PHELPS COMPANY, State and Rowland Streets, Detroit, Mich., represented by W. J. Phelps, had samples of its Hylo lamps in the hotel lobby. They were favorably commented on by many. In

addition to the ordinary filament, there is a small low candle power filament, cut in by slightly turning the lamp in its socket for use when a dim light is desired.

THE STANDARD PAINT COMPANY was fully represented, having in attendance Ralph F. Shainwald, president; Walter Cary, vice-president; J. C. Shainwald, western manager, Chicago; F. F. Vanderwater, New York. A handsome paper cutter souvenir was distributed by them.

MR. J. G. POMEROY, general western agent of the Adams-Bagnall Company at Chicago, was one of the well known men at the convention.

MR. THOMAS G. GRIER, of Chicago, western agent of the American Circular Loom Company, was about renewing acquaintances on his way home from an eastern trip.

MESSRS. JOHN T. MCROY and E. F. Kirkpatrick, among the best known men in the trade, were on hand to represent one of the important standard articles of the industry—conduits.

MR. S. L. KUEHMSTED, of the Gregory Electric Company, of Chicago, dealer in second-hand apparatus, was present and found the demand for such machinery larger than ever, owing to the crowded condition of factories and prevailing high prices.

MR. F. N. JEWETT, of the Evans Hot Water Heating Company, Chicago, was among the convention visitors.

MR. C. W. N. MONEY, representing the New England Electric Manufacturing Company, of Boston, gave much pleasure to the ladies by distributing large bunches of carnations among them; nearly every gentleman in attendance also wore a carnation by the courtesy of that company.

THE CROUSE-TREMAINE CARBON COMPANY, of Fostoria, Ohio, were represented by J. B. Crouse and H. A. Tremaine.

MR. NORMAN MCCARTY, general sales manager of the United States Carbon Company, was present making friends, as usual. The company is full of orders and pursuing the even tenor of its way.

MR. PAUL H. BRANGS, of the New York office of the Heine Safety Boiler Company, represented that company at this convention in his usual able manner. He is one of the very earliest builders of electric lighting dynamos in this country.

THE CRESCENT MANUFACTURING COMPANY, of Chicago, had Albert Meyer looking after its interests.

MR. N. C. COTABISH, general sales manager and also a director of the National Carbon Company, of Cleveland, represented the big carbon interests of which he handles the output.

THE GENERAL ELECTRIC COMPANY had parlors on the first floor for the reception of its numerous customers and station managers, etc. The courtesies were extended by Messrs. J. R. Lovejoy, W. Le Roy Emmet, E. E. Gilbert and H. W. Hillman, of the lighting department; A. D. Page and F. W. Willcox, incandescent lamp works; E. A. Carolan, foreign sales department; M. A. Oudin, E. H. Mullin and others, who, with above, were also active as escorts to the fine Pan-American exhibit of the company.

SAWYER-MAN ELECTRIC COMPANY was represented by C. S. Jennings, from New York; Frank S. Smith, G. A. Nellis, from Pittsburg. Henry Watts, from Buffalo.

MR. C. F. MUNDER had in hand the interests of the Munder Electrical Works, Springfield, Mass.

MR. E. W. KELLOGG represented the Frank Ridlon Company, of Boston.

STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, was represented by Messrs. W. B. Jackson, W. L. Fairchild and C. E. Bibber.

MR. L. R. WALLIS, of Woburn, found life too short to explain to all who wanted to know the features of his system of charging for current. The apparatus is now being built for him by the Stanley Instrument Company.

MR. JOHN H. DALE represented the Dale Manufacturing Company, of New York City. With him was O. J. Bryan.

THE ELECTRIC VEHICLE and RIKER MOTOR VEHICLE COMPANIES were most assiduously represented by Mr. J. M. Hill, who came down daily from their fine automobile exhibit at the show and whose courtesies in the way of "pick-up" rides in the handy vehicles were most gratefully appreciated by many of the members, to whom the serious lack of transportation facilities at present would otherwise have been a great drawback to their comfort and pleasure.

NATIONAL BATTERY COMPANY, of Cleveland, Ohio, were represented by Mr. Elmer A. Sperry. The Sperry battery is playing a prominent part in automobile work, and the company will, it is understood, build a large, new factory in order to be able to fill orders.

AM. DIST. STEAM COMPANY, of Lockport, whose exhaust steam heating system is in use by so many members, was represented by Mr. H. J. Babcock and C. R. Bishop.

THE ACME SWITCH COMPANY, of Hartford, Conn., was represented by Mr. G. L. R. Eldredge, who was doing his first N. E. L. A. convention, and rather liked it. The company is introducing a useful time switch, of which a large number are already in use by the Boston Edison Company.

MR. E. G. BERNARD attended for the E. G. Bernard Company, of Troy, N. Y.

MR. A. A. THRESHER, of the Thresher Electric Company, found a great deal of interest and curiosity existing as to the new vertical shaft generators of his concern, built for operation by waterwheels.

CARBOBUNDUM and ACHESON GRAPHITE COMPANIES, of Niagara, were represented by Mr. E. G. Acheson, president, and inventor of these new products of Niagara energy. The demand for carborundum, as an abrasive, etc., has already grown to amazing proportions.

THE FORT WAYNE ELECTRIC WORKS were represented by Mr. J. C. Lott, of New York, and A. E. Dresser, whose energetic efforts in their behalf were unremitting.

THE UNITED ELECTRIC COMPANY, of New Jersey, was represented by Mr. W. W. Titzell, superintendent of the Jersey City plant, and Mr. John J. Gaffney, of Newark.

THE LEA ELECTRIC MANUFACTURING COMPANY, Elwood, Ind., had W. M. Porter, its general sales agent, looking after its interests. They also brought an excellent male quartette of glee singers from their factory.

MR. FRANK H. CLARK, of Chicago, the new Helios Upton storage battery sales manager, was around shaking hands in his new capacity.

MR. C. W. COBB was in attendance in behalf of the Chicago Mica Company.

PRESIDENT G. A. MCKINLOCK, of the Central Electric Company, of Chicago, renewed many old acquaintances.

THE O. C. LITTLE PULLEY COATING COMPANY had a model in the hotel lobby showing the relative pulling power of a belt when on a smooth pulley and on one coated with the company's covering. The exhibit demonstrated that the coating doubled the cling of the belt.

THE CHICAGO BOILER CLEANER COMPANY, 321 Dearborn Street, Chicago, exhibited its new Electric Purifier for purifying oils, in charge of G. W. Atterbury. The company distributed free to oil users an inverted oil microscope for testing the purity of oils.

THE GOULD STORAGE BATTERY COMPANY was represented by Mr. W. W. Donaldson. This exhibit occupied a prominent position in the lobby of the International. There were shown plates formed and unformed, both positive and negative, from the smallest to the largest size. Among them were plates which had gone through a series of discharges representing over a year's work in ordinary use, and showing apparently no depreciation. The number of discharges to which they had been subjected was 317, with over 100 at a twenty minute rate, the same number at a half-hour rate, and one, three and eight-hour rates. "Spinning," the special method employed by the Gould Company for sub-dividing the lead and obtaining a large contact surface for the active material, was exemplified by numerous samples, showing a ratio of 20 to 1 and as high as 450 square inches per pound of lead. An automobile type was shown which with 13 pounds of element will give 100 ampere-hours at a four-hour rate, There were also shown different types of plates which had been recently installed at Mr. W. K. Vanderbilt's, Oakdale, L. I.; the Commercial Office Building, New York City; the Edison Station, Canton, Pa.; Lansing, Mich., Street Railway.

MR. CHARLES BLIZARD, general sales agent of the Electric Storage Battery Company, Philadelphia, took care of the interests of his company and participated in the battery discussion. He was assisted by Mr. A. Taylor.

MR. J. S. CRIDER represented the Washington Carbon Company of Washington, Pa.

STANDARD UNDERGROUND CABLE COMPANY was represented by Mr. T. E. Hughes, of Philadelphia; Mr. J. V. Marsh, of Pittsburg, and Mr. Charles J. Marsh, of the New York & New England territory.

MR. W. D. PACKARD looked after the interests of the New York & Ohio Company, of Warren, Ohio, and also talked automobile freely.

MR. J. S. SPEER, of the Speer Carbon Company, St. Mary's, Pa., who has recently been married, was accompanied by Mrs. Speer, and received the hearty congratulations of his many friends.

THE PITTSBURG TRANSFORMER COMPANY was well represented by Mr. F. C. Sutter, who reports that the transformer business was never better, and that they are running night and day turns to keep up with orders. This spring's business proved unusually large and the company, although still somewhat behind on shipments, is rapidly completing arrangements whereby stock shipments may be resumed.

AMERICAN ELECTRICAL WORKS, of Providence, were represented by Mr. F. E. Donohoe and Mr. W. J. Watson.

SAFETY INS. WIRE & CABLE COMPANY was represented as usual by Mr. Avery P. Eckert, whose work in connection with the Electrical Trades Society has given him an unrivaled acquaintance with the trade throughout the country.

PASS & SEYMOUR, the porcelain people of Syracuse, were represented by Messrs. John Brooks, F. M. Hawkins and B. E. Salisbury.

FRANKLIN ELECTRIC MANUFACTURING COMPANY, of Hartford, Conn., was represented by Mr. J. Gain, Jr., and Mr. G. D. Curtis.

MR. C. I. HILLS was not hard of hearing or of identification when the H. T. Paiste Company was mentioned.

OTIS ELEVATOR COMPANY sent Mr. A. H. Wright to the convention, and many wondered what had become of Benton.

MANHATTAN GENERAL CONSTRUCTION COMPANY was well represented by Messrs. S. Marsh Young and W. C. Hubbard, on behalf of the New York offices and Newark factory. They were assisted by G. B. Griffin.

THE SHELBY COMPANY had its efficient and energetic New York representative on hand, Mr. J. C. Wormley, who, if he had invented their lamp could not talk its points better or be more genuinely enthusiastic about it. He distributed a very ingenious card showing lamp measurements at various angles.

MR. PHIL ACKERMAN responded whenever the name of the Rhode Island Electric Works was mentioned.

ADAMS-BAGNALL ELECTRIC COMPANY was represented by Mr. W. V. Orr.

MR. C. H. BARKELEW spoke for the Barkelew Electric Manufacturing Company, Middletown, Ohio.

MR. A. C. GARRISON, of the Columbia Incandescent Lamp Company, of St. Louis, had some very effective badge buttons that were greatly in demand and adorned pretty well every lapel and shirt waist in the convention.

MR. F. S. TERRY was present for Sunbeam lamps. He is credited with carrying a focusing glass to which all other incandescent lamp beams are soon to converge. A "consolidation" of several lamp manufacturers is in the air, and they say Terry will manage it with headquarters in Chicago. If so, his opportunity, long and patiently waited for, to display his marked commercial abilities, has now arrived.

PACKARD ELECTRIC COMPANY, of Canada, was represented by Messrs. R. B. Hamilton and G. A. Powell.

THE SHAUGHNESSY AGENCY was all there in the persons of Mr. M. J. Shaughnessy and Mr. S. L. Coles.

PAGE ELECTRIC COMPANY, of Worcester, Mass., was represented by Mr. J. P. Coghlin and Mr. H. D. Perkey.

AMERICAN ELECTRIC HEATING CORPN. was represented by Mr. J. I. Ayer on behalf of the Simplex Company. Mr. Ayer has some exceedingly interesting problems on hand that involve novel uses of heating apparatus on a large scale. He can hardly refrain from talking about them.

"EMERSON" MOTORS, etc., were brought prominently to notice by Mr. H. L. Parker for the Emerson Electric Manufacturing Company, of St. Louis.

PHILLIPS INSULATED WIRE COMPANY, of Pawtucket, was represented by Mr. H. C. Adams, Jr.

NATIONAL CONDUIT—and J. P. McQuaide. Also McLean.

BAKER & Co., of Newark, was represented by Messrs. C. W. Baker, L. Le Sicla and C. O. Baker, Jr., who gauge the output of incandescent lamps by the demand for platinum.

AMERICAN VITRIFIED CONDUIT COMPANY, of New York, was present in the person of Mr. A. S. Barnard.

NEW YORK INSULATED WIRE COMPANY was represented by Mr. J. R. Cole, of 'Frisco, who does not get East quite often enough, but renewed many old friendships this time.

MR. G. E. DAVIS was present for the Motor & Equipment Company, of Newark, N. J.

THE DIEHL MANUFACTURING COMPANY was represented by Mr. B. C. Kenyon.

MR. CHARLES H. AUSTIN was present from Nashua, N. H., for the concern bearing his name.

ANSONIA ELECTRICAL COMPANY was represented by Mr. W. J. Tonkin.

MR. W. C. BENHAM represented his company from Columbus, Ohio.

THE GENERAL INCANDESCENT LAMP COMPANY, of Cleveland, Ohio, was represented by Mr. Joseph Insull. Great regret was expressed that labor troubles in New York detained his brother, Mr. Martin Insull, general manager of all the other "G. I." concerns. The General Incandescent Arc Light Company, of New York, was, however, represented by Mr. H. P. Ball. Mr. Samuel Insull was, as usual, one of the notable convention personalities, but attended as president of the Chicago Edison Company.

ELECTRICAL SUPPLY & MANUFACTURING COMPANY, of Cleveland, was represented by Mr. H. Whitford Jones.

JANDUS ELECTRIC COMPANY and the Jandus arcs were highly spoken of by Mr. G. W. Pope.

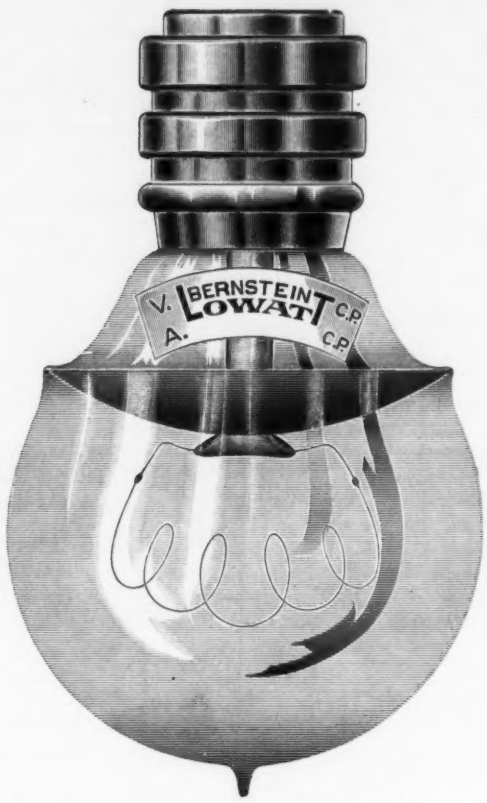
STANDARD CARBON COMPANY, of Cleveland, and Mr. A. D. Spear became closely identified by the members.

GEORGE M. GEST, of Cincinnati, was represented by Mr. T. E. Wood.

MR. MARCUS NATHAN came up to study the Pan-American in convention time. He will probably bring it to New York this fall.

MR. W. SMITH HORRY, well known from his connection with electric light invention and engineering, is now at Niagara Falls in connection with large carbide production, and is also engaged on work at Sault Ste Marie. He met a great many old friends at the convention.

A MONEY SAVER.



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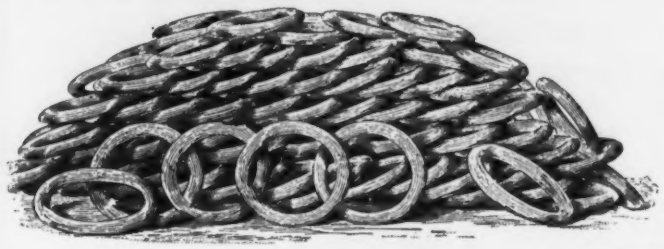

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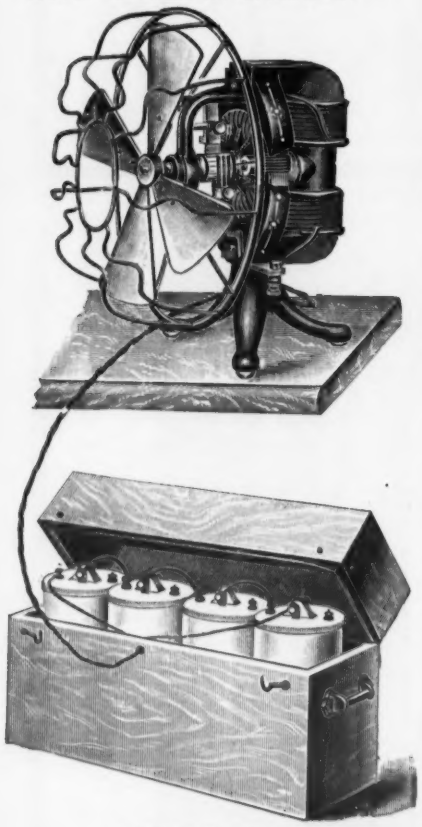

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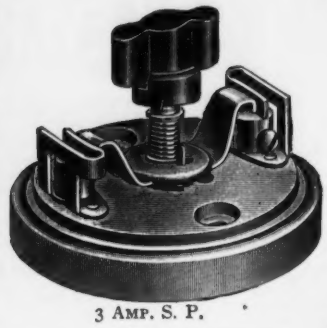
NEW YORK

SWITCHES FOR 500 VOLT CIRCUITS

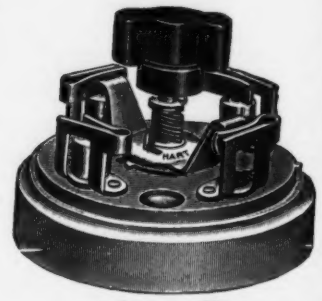
We make perfect Switches for every grade of work; these are for Street Car and other heavy circuit work — but we make all other grades as well.

Especially designed for Electric Heaters.
S. P.-Circuit broken at 4 points.
10 amp.

These switches are GUARANTEED **Thoroughly Insulated, Durable** and **Fully Capable** of the work for which designed.

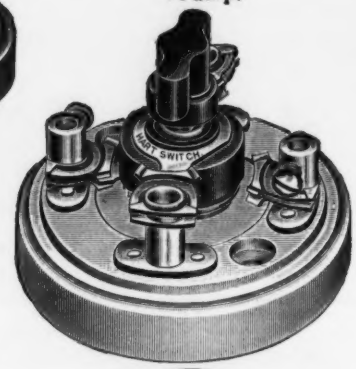


3 AMP. S. P.



1 AMP. —3 WAY.

Two-Circuit Switch especially designed for **lights on electric cars**—where there are four inside lights, and one at each end outside.



First two quarter-turns turn "on and off" inside lights and one of the end lights; next two quarter-turns turn "on and off" inside lights and other end light.

THE HART AND HEGEMAN MFG. CO.

216 UNION PLACE HARTFORD, CONN.

(B)

"CARTWRIGHT" ENCLOSED FUSES

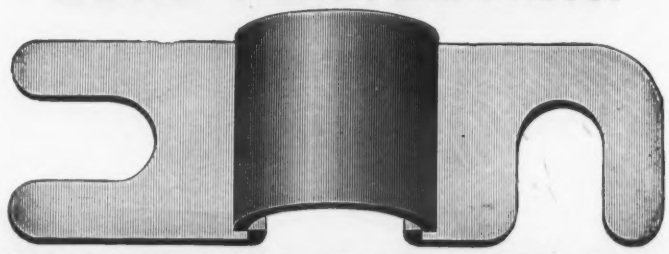
"SHAWMUT" TESTED FUSE LINKS

C. - S.

SURE PROTECTION!

S

Millions in property and thousands of lives are entrusted to their protection — and they never betray the trust. (1)



Their years of faithful service and the universal praise they receive for duty performed make them worthy of your confidence.

THE CHASE-SHAWMUT CO.
BOSTON, MASS.